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New Challenges for a New Era

Progress Through Innovation, Education and Research in North Carolina

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Final Report
of the
Governor's Task Force on Science and Technology

VOLUME II
ECONOMIC REVITALIZATION THROUGH TECHNOLOGICAL INNOVATION

N.C. Board of Science and Technology
Office of the Governor
Raleigh, North Carolina
January, 1984

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NEW CHALLENGES FOR A NEW ERA

PROGRESS THROUGH INNOVATION, EDUCATION AND RESEARCH IN NORTH CAROLINA

FINAL REPORT
OF THE
GOVERNOR'S TASK FORCE ON SCIENCE AND TECHNOLOGY

VOLUME II

ECONOMIC REVITALIZATION THROUGH TECHNOLOGICAL INNOVATION

N. C. BOARD OF SCIENCE AND TECHNOLOGY
OFFICE OF THE GOVERNOR
RALEIGH, NORTH CAROLINA
JANUARY, 1984

PREFACE

When the Governor's Task Force on Science and Technology was formed in August 1982, three standing committees were created: Elementary and Secondary Education, Research and Higher Education, and Technological Innovation. The committees drew their initial membership from the Task Force, but committee membership lists were also augmented with additional resource persons drawn from state government, academia, and the business community.

The Technological Innovation Committee, in particular, sought to draw participants from the five regional forums sponsored by the Task Force into the discussions of the Committee. As a consequence, a wide range of interests were represented on the Committee: small business, agriculture, state government, technology-based companies, venture capital, labor, and the university community.

The Committee initially considered the possibility of studying the role and impact of scientific and technological change on North Carolina society. But, because of time and resource constraints and the urgent need for new perspectives on economic development, the decision was made to concentrate the deliberations and activities of the Committee on the issue of "economic revitalization through technological innovation."

In addition to the development of this report, the Committee was involved with efforts to publicize the federal Small Business Innovation Research (SBIR) program, through a "Small Business Research and Development Conference" in January 1983 and a follow-up "Workshop on SBIR Proposal Preparation" in February 1983. The Committee was also involved with the development of concepts underlying the "New Technology Jobs Act" enacted by the General Assembly in July 1983.

The Committee wishes to thank Kirsten Nyrop for her staff support.

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ACKNOWLEDGEMENTS

Task Force members wish to express their appreciation to the hundreds of persons who contributed to this study, particularly associate committee members, regional forum participants, and state government personnel.

The Task Force was staffed by four persons who contributed to all facets of Task Force activities and drafted the final report. Tom Rudin was the principal author of Volume I; Kirsten Nyrop, Volume II; Shannon St. John, Volume III; and Sanford Shugart, Volume IV.

Task Force members and staff are extremely grateful to Brenda Pennington, Gail Whitaker, Ann Cooper, Linda Cox, Beverly Horne, Paul Price, Cathy Peeler, Ron Ennis and Leon Neal, for their dedicated commitment and various contributions to the Task Force effort. Special appreciation is extended to Don Phillips, Director of the N.C. Biotechnology Center, for his assistance. A number of interns and fellows also had important roles in the work of the Task Force.

TITLES OF EACH VOLUME

Volume I - A Vision of Opportunity

Volume II - Economic Revitalization Through Technological Innovation

Volume III - Research and Higher Education: Building a Foundation for Education

Volume IV - Public Education and the Technological Challenge

Supplemental reports have been prepared by the Task Force's Committees on Agriculture and Forestry, N.C. and the World Community, and Science, Technology and Human Values.

All four volumes and copies of the supplemental reports can be obtained upon request from:

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ECONOMIC REVITALIZATION THROUGH TECHNOLOGICAL INNOVATION

INTRODUCTION

New products, processes, substances and professions are being created seemingly overnight, redefining virtually every aspect of human endeavor. Scientific and technological advances of unprecedented scope and magnitude have been at the heart of this change over the past decade, and the prognosis is for even greater changes in the decades to come. Food and fiber, medical care, transportation, communication, entertainment, education, national defense, energy -- all have been challenged and changed by "technological innovation" -- a combination of technical advances and organizational innovations.[1]

The American public has taken a growing interest in the implications of technological innovation for all aspects of human activity. School curricula are being revised to place greater emphasis on mathematics and science education. Schools of engineering are developing new programs in robotics, genetics, aerospace, energy and environmental sciences. Mechanization, the use of chemicals, and genetic engineering have improved crop yields, decreased crop losses, and increased efficiency in farm operations.

Technical innovations have improved the size, power and price of computers and related equipment. These improvements, in turn, have enabled individual firms to change the way they organize and manage their operations, with changes ranging from the maintenance of payroll and personnel records to oversight of production, inventory and sales. Similarly, technical breakthroughs in microelectronics and robotics have enabled extensive mechanization of the textiles and automotive industries. This mechanization, in turn, has led to fundamental changes in the numbers and types of personnel employed by these basic industries.

Yet, at the same time that the arrival of a "New Technological Age" has been heralded with hope and great expectations, growing numbers of people are realizing that technological innovation is not a panacea or "cure-all" for most of society's intractable problems, and still others are warning of the dangers of too much change in too little time.

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[1] Technological innovation can be viewed as consisting of two interrelated parts: technical innovation and organizational innovation. "Technical innovations" enable the more efficient production of new and better physical or biological products and are dependent upon advances in the natural sciences, engineering and mathematics. "Organizational innovations," on the other hand, are associated with changes in the organization and operation of units of society. They are influenced by the social and behavioral sciences, and are often associated with technical advances. For example, the development of the internal combustion engine was a technical innovation, but the manner in which entrepreneurs devised new modes of transportation to capitalize on this invention was an organizational innovation.

One aspect of technological change, in particular, has received considerable attention from the press and public: the implications of scientific and technical advance for employment opportunities and overall economic development. Monthly reports on job losses and openings, as well as plant closings and the start-up of new multi-million dollar companies, are the subjects of widespread public debate and of great interest to policymakers. More than 25,000 businesses filed for bankruptcy in the United States in 1982, while 567,000 new companies were started. 211,000 autoworkers and 119,000 steelworkers are idle, while by 1985 the New England area alone expects the demand for laser technicians to increase as much as one thousand percent. All indicators point to an economy in transition -- a "New Economy" and potential "reindustrialization" based on new technologies.

North Carolina at the Crossroads

The paradox of declining traditional industries and growing advanced-technology[1] firms also characterizes the North Carolina economy. Over 10,000 textile workers were laid off in 1982, while employment in technology-based companies accounted for as much as 25 percent of the growth in manufacturing jobs in the state between 1975 and 1980. Unemployment rates range from as low as 4.3 percent in the Research Triangle area to as high as 18 percent in Franklin County (August 1983). In 1982, North Carolina had more plant closings than any other state in the nation; at the same time, new and expanded industrial investments created over 22,000 jobs.

In the same way that the United States and other industrialized nations are at the crossroads, North Carolina faces important challenges and choices in efforts to promote job creation and economic progress. The challenge is to capitalize on the opportunities provided by technological innovation and to avoid the potential pitfalls. The critical choices made today will determine the success with which the state meets this challenge and guides its economic future.

A basic premise of this report is that we cannot afford to permit ad hoc decisions and actions to determine our economic future. We cannot afford to ignore signs of trouble and simply hope for indications of progress. Instead, we have an opportunity and a responsibility to fully understand both the potential and limits of technological change, and to harness and guide this change for the achievement of a wide range of social, economic and environmental goals.

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[1] In this report, the terms "high," "advanced" and "new" technology will be used interchangeably to refer to forms of technological innovation. "High" technology is generally used in conjunction with such industries as telecommunications, microelectronics and biotechnology. But technological innovation is not limited to these new industries; technological advance also includes change in traditional industries. The preferred term, therefore, is "new" technology.

The overriding concern of this volume is the creation of more and better jobs for North Carolinians at all skill and age levels in all regions of the state. As the North Carolina economy shifts from manufacturing to service industries and new technologies revolutionize the workplace, economic development policy must focus, in particular, on the need to create new jobs as well as fill existing jobs with qualified workers and trained professionals.

More than 300,000 North Carolinians are out of work, and an additional 400,000 are underemployed in jobs that offer little pay or little future. In some cases, the jobs simply no longer exist; international competition and the recession have forced industries to lay-off workers, and expectations are that most of these workers will not be rehired. In other instances, the unemployed lack the skills needed for jobs in which there are new openings.

Volumes III and IV of the Task Force report focus on research, education and training for a new economy. Research and Higher Education: Building a Foundation for Innovation outlines initiatives to strengthen research and academic institutions in North Carolina. Public Education and the Technological Challenge focuses on initiatives for improving science and mathematics education in our elementary and secondary schools.

Education, training and research are fundamental to economic and social progress. North Carolinians need to be prepared for a rapidly changing job market, and businesses located in the state need an assured supply of the numbers and types of workers that they require.

This volume (Volume II), in turn, focuses on new initiatives to promote economic revitalization through technological innovation. It provides an overview of the North Carolina industrial base, focusing on the growing importance of new-technology firms, the shift from manufacturing to service industries, and the continuing importance of such traditional industries as textiles and agriculture. The report notes the important resources that already exist in North Carolina to promote technological innovation, such as the Microelectronics and Biotechnology centers. The need for leadership and partnerships between government, business, labor, educational and research institutions, the financial community, and the public at large is emphasized in the development of far-sighted policies and programs for technological development.

The central focus of the report is a proposed "North Carolina Strategy for Economic Revitalization Through Technological Innovation." This strategy for reindustrialization focuses on initiatives in three areas: (1) recruitment and expansion of new-technology firms, (2) fostering innovation in traditional industries, and (3) the start-up of new small businesses. A new perspective is provided on the relative importance of each of these components of economic development. Within each of these areas, a number of financial, technical and organizational innovations are recommended to promote economic revitalization and job creation.

The implications of technological innovation for concerns such as environmental management, medical care and public health, local government, transportation, and communications in North Carolina are as important as the implications of scientific and technological advance for jobs and the overall economy. Each of these topics merits the careful and extensive consideration accorded the issue of economic development. However, because of time and resource constraints, and the urgent need for new initiatives to promote reindustrialization, the Task Force and its associated Committee on Technological Innovation focused its discussions and actions on the issue of "economic revitalization through technological innovation." The Task Force therefore recommends:

- Indepth Studies of Science and Technology

  The N.C. Board of Science and Technology should continue its efforts to assess the impact and role of technological innovation in the achievement of a wide range of social and economic goals. Examples of goals meriting special attention from the Board include but are not limited to the establishment of improved communication and transportation links among all parts of the state, and the use of medical advances in addressing important public health concerns. This recommendation could be accomplished within the existing mandate of the Board, but an additional appropriation for staff support may be required.

Chapter One

NORTH CAROLINA'S STRATEGY FOR ECONOMIC REVITALIZATION

California and Massachusetts have received national recognition as leaders in spawning and fostering high-technology businesses. With the decline of such traditional industries as automobile and steel manufacture -- and reports of the economic successes of high-tech entrepreneurs and high-risk venture capitalists -- other states, as well, have launched concerted efforts to attract high-technology businesses and to support indigenous entrepreneurs and firms in advanced-technology endeavors.

States known for their technology-based industry are developing new measures to retain their leadership position, but competition for a piece of the high-technology pie is coming from all regions of the United States. High-technology initiatives are being developed in states ranging from those which are only beginning the process of industrialization, to long-standing industrial states which are seeking to reindustrialize as their traditional sources of economic growth and vitality lose their competitive edge.

North Carolina has also entered the competition for technology-based firms and jobs. North Carolina's success in the competition for a share of new technology-based industries -- as well as the extent to which these new firms promote economic growth and prosperity throughout the state -- depends on the development of far-sighted and workable responses to two interrelated questions: (a) What technology-based businesses and practices are in the best interests of North Carolina? (b) What strategies should North Carolina pursue to create an economic, social, cultural and political climate conducive to the promotion of technological innovation throughout the state's industrial base?

Planning for Technological Change

As a matter of state and local government policy, the first priority is proper planning for technological change. The new technology-based businesses and practices attracted to and fostered in North Carolina through government policies and actions must promote increased productivity, both in the manufacture of products and in the delivery of services. Improvements in the quality of products and processes are integral to a concern with increased productivity. Both improved productivity and quality are essential to keeping North Carolina products and services competitive in national and international markets. The competitiveness of North Carolina industry is fundamental to the overall goal of more and better jobs for North Carolinians at all skill and age levels in all regions of the state. Technological innovation can and should also play an important role in the achievement of other economic and social goals, including:

- more efficient use of scarce resources such as energy, water and prime farm land;
- less expensive yet improved compliance with environmental and occupational health regulations; and

- maintenance of the public infrastructure (particularly transportation networks, and water and sewage disposal systems), and social services.

An important first step, therefore, is the identification of social and economic goals which may be enhanced or impeded by technological development; not all aspects of technological advance may be in the best interests of the state and its citizens. The next step is to plan and guide technology-driven change in accordance with these goals.

A 1981 visit by eight government officials from the City of Raleigh and Wake County to California's Santa Clara Valley illustrates the importance of this approach to planning. The officials visited "Silicon Valley" in an effort to learn how local services had been affected by the tremendous growth of the microelectronics industry in that area over the past two decades. Members of that trip described the two sides of rapid industrial development in an article for N.C. Insight (1983):

> Microelectronics and associated development turned Silicon Valley into one of the most affluent regions in the nation for the private sector. But the public sector has not fared nearly as well. Although a few of the communities -- notably Santa Clara -- appear to have managed well enough, others are hard pressed to provide public works and services enough to catch up with the boom, let alone get ahead of it. There are serious problems with solid and liquid waste disposal, the transportation system, fire protection, increasing crime rates and the beginning of slums. Air pollution from heavy traffic is a problem some of the time.

The problem identified by the visitors from North Carolina was that "local government officials in silicon valley were not accustomed to systematic intergovernmental coordination or close coordination with industry and were not disposed to give planning high priority in policy, administrative, or operational affairs."

On the basis of their analysis of the Santa Clara Valley experience, a number of recommendations for land use planning were developed for Raleigh and Wake County. The recommendations were designed to avoid traffic congestion, preserve open space and farmland, make the best use of existing municipal services and facilities, and accurately monitor changes in population size.

The problems facing the Research Triangle area, currently and potentially, also confront cities and towns throughout the Piedmont region. Industries and workers attracted to North Carolina from other states have located primarily in the Piedmont. The central part of the state has a disproportionate share of the new technology-based firms that are "spin-offs" of these firms and the state's research universities and medical schools. In sum, the Piedmont region is experiencing more rapid industrial growth and development than other regions of the state, both in relative and in absolute terms.

One implication of this trend is that the economic development gap between the Piedmont and other regions of the state may be widening instead of narrowing. While many technology-based firms have been started or have located in the Coastal Plains and Mountain regions, the challenge of fostering economic development in all areas of the state remains a high priority.

A second important implication is that local governments in the Piedmont region have a special responsibility to anticipate and plan for rapid economic development. They should give special attention to increased demands on water supplies, sewage disposal systems, schools, transportation, and housing. Local governments have an opportunity to capitalize on the prosperity associated with rapid industrial development, but they also have a special responsibility to avoid the congestion and crowding that characterize Silicon Valley.

Cooperative planning for proper land use, avoidance of strains on local services and facilities, and concerns with the overall quality of life generally focus on the issues of how much industrial development is desired and where that development should be concentrated. A related planning question is what types of industrial development are in the best interests of the state and its citizens? This question focuses on whether and to what extent development should be targeted at certain types of industries and firms. Three important factors to be considered are: (1) numbers and types of jobs, (2) impact on the environment and natural resources, and (3) implications for worker safety and health.

Increased employment opportunities are clearly a priority consideration in addressing the issue of the types of industries and firms that are in the best interests of the citizens of North Carolina. The extensive industrial recruiting efforts of the N.C. Department of Commerce are driven by the need to create job opportunities for a growing working-age population.

The issue, however, is not merely one of more jobs, but also one of higher-paying and upwardly-mobile jobs. Certain sectors of the North Carolina economy are still very "low-wage". Industrial recruiting and other economic development efforts should focus on firms and industries that will not only provide new jobs, but also raise the wage rate and provide opportunities and training for promotions to new responsibilities.

More and better job opportunities must be provided not only for skilled technicians and professionals, but for unskilled and semi-skilled workers as well. Providing job opportunities for production workers is particularly crucial in North Carolina, as workers laid off by the textile and apparel industries are forced to find new jobs. Finally, and perhaps most importantly, more and better job opportunities for workers at all skill and age levels must be available throughout the state, not merely the Research Triangle and other areas of the Piedmont.

The potential impact of industries on the environment and natural resources must also be considered in discussions of targeting certain types of industries and firms. The link between industrial development and environmental protection has already been established in North Carolina:

- Since 1971, the departments of Commerce and Natural Resources and Community Development (and their predecessors) have been required by law (G.S. 143B-437) to "conduct an evaluation...of the effects on the State's natural and economic environment of any new or expanding industry or manufacturing plant in North Carolina."

- In 1980, a Toxic Substances Management Project was established within state government by the N.C. Board of Science and Technology to determine the potentially hazardous effects of the most widely used chemical substances in North Carolina.

- The General Assembly enacted the Waste Management Act of 1981, leading to the establishment of the N.C. Waste Management Board and the creation of mechanisms for dealing with hazardous and low-level radioactive waste.

New technologies have been used to reduce the generation of hazardous waste and enable more efficient use of natural resources. But it cannot be taken for granted that technology-based firms will necessarily generate lower volumes or less toxic waste, or place relatively fewer demands on land and water resources than traditional industries. In fact, the microelectronics industry generates a significant volume of chemical waste that must be disposed of properly. The changing industrial base of the state provides new opportunities and new responsibilities for the careful assessment of the potential impact of firms and industries on our environment and natural resources.

The issue of worker safety and health is closely related to concerns with the environment and natural resources. For example, great uncertainty surrounds discussions of the impact on worker health of various stages of the production process in the microelectronics industry.

The relative newness of technology-based industries has made assembling conclusive evidence on health and safety issues in this sector of the economy particularly difficult. Therefore, the most reasonable response at this time is to carefully monitor worker health and safety in all North Carolina industries, and to encourage full cooperation from both industry and labor. Existing monitoring systems may need adjustment to meet the special challenge of overseeing new technology-based firms.

Far-sighted and effective planning for technological development at all levels of government -- as a cooperative effort involving industry, labor, the education community, and the public at large -- is the challenge of the 1980s. The question is not whether North Carolina's industrial base will be changed by scientific and technological advances, but to what extent, in what sectors, and to what effect for state and local governments, workers and the general public.

Strategy for Economic Revitalization Through Technological Innovation

Three industries -- textiles and apparel, agriculture and forestry, and furniture -- have historically served as North Carolina's economic base and have been the primary focus of industrial development efforts.

Since the late 1950s, however, industrial development efforts in the state have focused increasingly on the opportunities provided by high-technology industries. As early as 1956, former Governor Luther Hodges met with representatives from the three lead universities in the Triangle and the local business community to discuss the concept of a research park. The Research Triangle Park actually became a reality in the mid-1960s, when IBM and the federal Environmental Protection Agency located in the area. Encouraged by the success to the Research Triangle Park, economic development efforts in North Carolina have focused on the recruitment of high-technology firms, particularly over the past six years.

Under the leadership of Governor James B. Hunt, Jr. the state's economic development strategy has also included direct state funding for high-technology centers, such as the Microelectronics Center of North Carolina and the North Carolina Biotechnology Center.

In addition to recruitment and high-technology research centers, a third component of the state's economic development strategy has been infrastructure support for industrial and residential development. Water and sewer systems have been expanded to meet the demands of industry and a growing population. The state's network of roads and highways, railroads and inland waterways is extensive, and an increasing number of communities are gaining access to air transportation.

Efforts to strengthen and upgrade science and mathematics education in the state's elementary and secondary schools are also considered important components of an overall economic development strategy. The North Carolina School of Science and Mathematics is an example of a new initiative in education.

The state has a history of cooperation between government and business in efforts to promote industrial development. Taxes are low and regulations are considered fair. North Carolina has an ample supply of quality land, and the climate is good.

In other words, a strong base -- human, physical, financial, and political -- has been established in North Carolina to promote high-technology industry. But the challenge over the next several decades is to build upon that base and to develop new initiatives designed to stimulate technological innovation throughout the North Carolina industrial base. The transition from a traditional economy based on agriculture and manufacturing in textiles and furniture, to a new economy characterized by a growing service sector and advanced-technology industries has only begun in North Carolina. This transition will be difficult and costly unless the North Carolina economic development strategy is infused with new perspectives and new initiatives.

A New Perspective. North Carolina has an impressive record in industrial recruiting. New industrial investments in 1982 totaled $409.6 million -- about one-quarter of the 585 industrial projects announced last year. Two-thirds of these new investments were in communities with populations under 15,000. Industrial recruiting has taken on new importance as the state seeks to capitalize on the impressive growth potential of high-technology firms.

At the same time that the state has sought to recruit new technology-based firms, efforts have also been made to increase the substantial base of innovative firms already located in the state. High-technology companies in such areas as microelectronics, biotechnology and robotics already employ 147,089 North Carolinians. As these companies grow and expand, they will provide additional employment opportunities.

Data from the N.C. Employment Security Commission (Table 1A) indicate that 6.36 percent of all jobs in North Carolina were in firms classified as "high technology." This does not necessarily imply that 6.36 percent of all jobs in the state are in high-technology areas; high technology firms hire workers at a variety of skill levels. Similarly, there are high-technology jobs in traditional industry. The estimate of 147,089 jobs in high-technology firms, therefore, should be used with caution.

The ESC data provide some insight into the manufacturing orientation of high-technology firms in North Carolina. Fifty-nine percent of the jobs in high-technology firms in North Carolina are in manufacturing, compared to 34 percent of all jobs. Jobs in high-technology firms comprise 11 percent of the jobs in manufacturing firms in the state. The data, however, do not indicate the levels and types of skills required by these high-technology firms, both in manufacturing and non-manufacturing plants.

TABLE 1A

TOTAL,"HIGH TECHNOLOGY" AND "ALL OTHER" FIRMS AND THEIR EMPLOYEES, 1982

Type of Firm	All Firms	High Technology Firms	All Other Firms
	Number (Percent)	Number (Percent)	Number
		Number of Firms	
Manufacturing	10,452 (8.23)	463	9,989
Non-Manufacturing	116,539 (91.77)	3,207	113,332
Total	126,991 (100.00)	3,670 (2.88)	123,321
		Number of Jobs	
Manufacturing	785,038 (33.94)	86,813	698,225
Non-Manufacturing	1,527,514 (66.06)	60,276	1,467,238
Total	2,312,552 (100.00)	147,089 (6.36)	2,165,463

Source: Employment Security Commission of North Carolina (unpublished data), June 9, 1983.

TABLE 1B

EMPLOYMENT IN "HIGH TECHNOLOGY" SIC CODES

SIC Code	Number of Firms	Average Annual Employment
	Manufacturing Firms	
283 Drugs	25	9,145
348 Ordiance and Accessories Except Vehicles and Guided Missiles	2	4
357 Office, Computing and Accounting Machines	38	15,096
361 Electric Transmission and Distribution Equipment	32	5,477
362 Electrical Industrial Apparatus	39	8,122
363 Household Appliances: Micro Applications	19	5,564
364 Electric Lighting and Wiring Equipment: Miniaturization of Circuitry	45	7,229
365 Radio and T.V. Receiving Equipment, Except Communication Types	9	958
366 Communication Equipment	34	14,774
367 Electric Components and Accessories	54	5,101
369 Miscellaneous Electrical Machinery, Equipment and Supplies	26	4,837
372 Aircraft and Parts	12	707
379 Miscellaneous Transportation Equipment	20	300

TABLE 1B (continued)

SIC Code	Number of Firms	Average Annual Employment
381 Engineering, Laboratory, Scientific, and Research Instruments and Associated Equipment	8	462
382 Measuring and Controlling Instruments	31	3,204
383 Optical Instruments and Lenses	2	12
384 Surgical, Medical and Dental Instruments and Supplies	47	3,395
385 Ophthalmic Goods	7	113
386 Photographic Equipment and Supplies	4	1,543
387 Watches, Clocks, Clockwork Operated Devices and Parts	9	771
	Non-Manufacturing Firms	
481 Telephone Communication	150	22,522
482 Telegraph Communication	12	210
483 Radio and T.V. Broadcasting	283	5,578
489 Communication Service	97	1,484
737 Computer and Data Processing Services	368	4,760
739 Research and Development Laboratories	2,242	23,525
892 Noncommercial Educational, Scientific and Research Organizations	55	2,197
TOTAL	3,670	147,089

Source: Employment Security Commission of North Carolina (unpublished data), June 9, 1983.

Industrial recruiting is likely to continue playing an important role in efforts to promote economic prosperity in North Carolina over the next five to ten years. However, with most states developing special marketing programs to compete for a share of the high-technology pie, placing sole or even primary reliance on industrial recruiting as a vehicle for ensuring future economic growth and prosperity is not in the best interests of North Carolina. Regardless of the phenomenal growth potential of high-technology industries, there will ultimately be a finite number of firms and corporations for which the competition among the states will be tremendous. No state is guaranteed to win the recruitment sweepstakes, despite the best efforts of highly competent individuals in both the public and private sectors.

Some states have placed virtually exclusive emphasis on the development of a high-technology industrial base. High-technology industries can hold great promise for states that have never had an extensive industrial base, or states whose base in such traditional industries as steel and automobile manufacture has eroded beyond repair over the past several decades.

But North Carolina is uniquely situated to place equal emphasis on both new and traditional industries, thereby avoiding the massive financial outlays and extensive dislocation generally associated with radical changes in an industrial base. North Carolina's traditional industries -- agriculture, textiles, apparel and furniture -- are already undergoing significant changes in their efforts to survive the economic recession and regain their position in international markets. These industries are still viable and they remain the state's leading sources of employment. The challenge is to encourage the appropriate use of technical advances and organizational innovations to maintain the state's base in traditional industries.

In North Carolina, the choice is not between high-technology industry and traditional industries. That is a false choice. Instead, the focus in policymaking is on how best to strengthen our existing industrial base while enhancing that base with fast-growing, high-technology companies.

Therefore, an alternative approach to economic development and job creation through technological innovation in North Carolina's industrial base is one that rests on a combination of short- and long-term strategies. In this approach, industrial recruiting is an essential short-run strategy for the next decade, but one which should decrease significantly in importance thereafter. A medium-term strategy for the next several decades is the encouragement and support of innovation in traditional North Carolina industries, with the aim of ensuring the continued vitality of individual firms and entire industries well into the next century.

In the long-run, however, a key to economic prosperity and the creation of new and better jobs for North Carolinians rests with initiatives to help individual inventors and entrepreneurs start new small businesses and to help existing small firms to expand and thrive. Small firms are already the backgone of the North Carolina economy; 97 percent of firms in the state are small businesses with less than 100 employees. The creation of new small businesses and improvement of the survival rate of existing small firms must increasingly become the central focus of economic development policies and initiatives in North Carolina.

The Importance of Education and Training

Since the mid-1960s, when the first large-scale studies of education in the United States were published, a national consensus has been developing among leaders in government, business, labor, and the public at large on the importance of excellence in education for social and economic progress. It has become increasingly clear that the most fundamental prerequisite to economic growth is a workforce trained in the skills and educated in the areas of expertise needed by business and industry. With this consensus has come the realization that significant investments are required at all levels of education to improve (1) student enrollment and performance, (2) the supply and quality of teachers, and (3) the availability of laboratory and instructional materials and equipment.

In North Carolina, there is a consensus on the need for renewed emphasis on the basics taught in our elementary and secondary schools. In an era of discovery, those who lack the basic reading and writing skills with which to acquire, use and share information will be increasingly excluded from the potential benefits of a technology-based era. Unless basic education becomes a top priority of society, the gap will widen -- not narrow -- between those who have received a good basic education and those who have not.

In addition to renewed emphasis on basic education, our students also need training in the "new basics" -- the ability to communicate effectively, solve problems, and think critically. And they need "learning to learn" skills to prepare them for further education and training on-the-job or in our institutions of higher education. In particular, there is a growing need for a high level of general scientific and technical literacy among all students. More students need preparation in the basics of science, mathematics and computer science to prepare them for jobs upon graduation and enable them to continue their education in institutions of higher education. (Specific steps to strengthen science and mathematics education in elementary and secondary schools are proposed in Volume IV, "Public Education and the Technological Challenge.")

North Carolina must also maintain a base of excellence in all of the state's institutions of higher education, particularly in the scientific and technical fields and in business education. The state's universities, colleges and community colleges are responsible for providing the skilled workers, the trained technicians, and the scientific, engineering and business professionals that are crucial to advanced-technology production. North Carolina's public and private institutions of higher education must attract and retain instructors and faculty members of high quality, and they must have the specialized equipment and facilities needed for scientific and technical education, training and research.

Finally, institutions of higher education must have the flexibility and resources with which to develop specially-tailored training programs. These programs and other efforts to meet the growing and changing needs of businesses must, in turn, be developed on the basis of accurate and current information about the job market. (See Volume III, "Research and Higher Education: Building a Foundation for Innovation" for specific recommendations.)

Education and training strategies focus largely on filling job openings that already exist or are projected to exist in the future. But education and training strategies can also have an important role in creating new jobs. Through education and training, North Carolinians can develop ideas for new or improved products and services, and they can acquire the skills needed to run a successful business. Similarly, research conducted at institutions of higher education can often be translated into marketable products or services. Many universities have histories of collaboration with industry in the conduct of both basic and applied research. The success of industrial recruitment efforts hinges upon the quantity and quality of the labor pool.

Volume II, therefore, builds upon the potential of education, training and research strategies to foster the creation of new jobs, but it focuses on the important additional initiatives -- in the provision of technical, management and financial support -- that are critical to economic revitalization through technological innovation.

The Service Sector -- A Special Concern

Most strategies for economic development focus on employment opportunities in the manufacturing sector. This volume, as well, emphasizes the need to retain manufacturing jobs in traditional industries and on creating new manufacturing jobs in emerging high-technology industries. But it is important to note that manufacturing currently accounts for only one-third of the jobs in North Carolina. However, firms engaged in manufacturing provide 59 percent of the jobs in "high-technology" companies in the state. These figures appear to indicate that "high technology" firms could play a major role in efforts to retain the state's manufacturing base. As of 1982, jobs in "high technology" firms comprised 11 percent of all manufacturing jobs and 6.36 percent of all jobs. The remaining two-thirds of all jobs in North Carolina are in research and academic institutions, R&D firms, and particularly the service sector.

"High technology" research and development laboratories and noncommercial educational, scientific and research organizations currently provide only a small percentage of the jobs in the state, but they comprise as much as 17 percent of the jobs in the "high technology" sector. It is anticipated that the activities of the Microelectronics Center of North Carolina (MCNC) and the North Carolina Biotechnology Center (NCBC) will stimulate the creation of new employment opportunities in research and development firms, through the relocation of companies and the start-up of new small businesses.

While manufacturing and R&D firms are important components of the North Carolina economic base, an economic development strategy for the state must also consider the growing importance of the service sector.

Scientific and technological advances have the potential of creating new jobs not only in manufacturing and R&D activities, but also in the service sector. Computer technology has opened up entirely new service industries in such areas as telecommunications, data processing, systems analysis, and business and military problem-solving. Increasing numbers of people are being trained in the use of computers in medical diagnosis, chemical analysis and geological prospecting. There is a growing demand for "robot doctors" trained in engineering, computer hardware, and computer programming. People with backgrounds in the liberal arts and business are being hired as technical writers and in the sales and marketing departments of high-technology firms.

In North Carolina, 910 firms employing 34,554 persons are engaged in "high technology," non-manufacturing aspects of telephone or telegraph communications, radio and television broadcasting, communication service, or computer and data processing services.

The computer software industry, in particular, has the potential of creating new job opportunities in all regions of the state. The software product and service industry began in the late 1960s and has since then become a $7 billion industry nationwide. The prediction is that this industry will grow to about $34 billion by 1987. There are about 7,100 computer software companies in the United States, most of them located in California, Texas, Massachusetts, Florida, and Georgia. Although North Carolina is a relative newcomer to the computer software industry, the expectation is that recruitment efforts targeted at microelectronics firms will, in turn, stimulate the growth of the software industry in the state. Some of the new firms will be "spin-offs" from existing companies; many software entrepreneurs in North Carolina started with such large companies as IBM and Data General. Other firms will be "home grown" by enterprising individuals with the knowledge and time to write software programs, incorporate, and sell their product. The advantage of software companies is that they are labor-intensive instead of capital-intensive; they require trained and enterprising individuals, but relatively little capital, to get started.

The service sector in North Carolina will not only be characterized by employment opportunities in service-oriented firms associated with a growing "high-technology base," but it will also be characterized by growing numbers of public and social service jobs.

For example, the North Carolina population ages, there will be a growing demand for services for the elderly. People will be needed to assist senior citizens with household chores, provide health care, administer social service programs, and otherwise enhance the quality of life of the elderly. As consumer incomes and concerns with good health increase, there will be a growing demand for people engaged in the delivery of health and medical care, ranging from nurses aides and orderlies to administrators, medical technicians and physicians. With more women entering the workforce, there will be a growing need for child care services. As we learn more about the human development and proper care of the handicapped, new employment opportunities will be created in this area of social service as well.

Most jobs in service firms associated with new technologies will require education and training, either in technical/scientific areas or in sound business management, or both. Even jobs in sales and marketing can hold promise of good starting wages and upward mobility, depending upon the company. Similarly, the growing public and social service sector is providing increased opportunities for skilled workers and trained professionals. Within each social service organization, there are opportunities for persons with a variety of skills and a range of skill levels. When there are opportunities for training, there is the potential for upward mobility in these organization even for relatively unskilled workers.

This potential for upward mobility in social service jobs does not necessarily exist in the third and final component of the service sector -- the low-skill, low-wage service sector. This sector includes low-skill clerical personnel, lower-level salespersons, restaurant and fast-food service employees, and service station attendants. Unless employment opportunities are created in manufacturing, R&D firms and in social service organizations, the bulk of jobs for lower-skilled workers in North Carolina will be in the low-skill service sector where wages are low and opportunities for personnel advancement are limited. The Task Force therefore recommends:

o Job Creation

The creation of higher-wage, upwardly-mobile jobs for North Carolina's unskilled and semi-skilled -- as well as skilled and professional -- workforce must be the top priority for economic development policies and initiatives. Implementation of this recommendation implies the development of new policy perspectives and a possible reorganization of Commerce Department efforts, but no additional expenditures should be required.

For the purposes of effective policy development and proper planning, it is important to know the precise composition of the North Carolina economic base and workforce. Recordkeeping in the N.C. Department of Commerce focuses largely on firms and jobs in manufacturing. The Task Force therefore recommends:

o Expanded Mandate for N.C. Department of Commerce

The N.C. Department of Commerce should expand its recordkeeping and industrial development activities to include the growing service sector. Implementation of this recommendation could necessitate the hiring of additional staff, requiring additional expenditures within the Commerce Department of $100,000 to $150,000 per year.

Economic Opportunities for Women and Minorities

Throughout this volume, the focus is on the need for more and better job opportunities for all North Carolinians -- men and women, minorities and non-minorities, old and young people, skilled and unskilled workers, the handicapped, residents of inner-city neighborhoods and rural communities. Individual groups in North Carolina society with particularly acute needs for more and better employment and business opportunities have not been singled out for special mention or special programs.

The fact that the special needs for particular population groups -- such as women and minorities -- have not been singled out for special attention or new programs, however, should not be construed to imply a lack of understanding or sympathy for these special needs. Instead, the findings and recommendations contained in this volume are based on the premise that most of the needs identified for workers, business owners and the public in general are even more acute and pressing among certain population groups.

For example, the general concern with improving wage rates among North Carolinians follows from the knowledge that women in the workforce often receive only 54 to 62 percent of the wages of their male counterparts in similar occupations. Similarly, general concerns with stimulating the start-up and success of small businesses follow from the knowledge that minorities participate in business ownership at only one-fifth the rate for non-minorities; historically, there have been only 14 minority-owned businesses for each 1,000 minority persons, compared to 63 businesses for each 1,000 non-minority persons.

The hope, therefore, is that the findings and recommendations of this volume will, at times, be used as a baseline for additional findings and recommendations targeted at special population groups, where appropriate. In many cases, the recommendations set forth in this volume will adequately address the needs of all population groups; at other times, additional targeted programs and policies may be required.

Building Upon Existing North Carolina Resources

The strategy for economic revitalization developed in this report assumes continued and even increased support for existing resources designed to promote technological innovation. Because of these resources, North Carolina has recently moved into the forefront of scientific and technological development in this country. Capitalizing on the outstanding resources within its public and private institutions of higher education, and moving to establish the Research Triangle Park as an international center of scientific advancement, North Carolina has pursued an aggressive course in improving its scientific and technological base.

A variety of institutions and organizations have, over the years, taken steps to enhance the state's science and technology base. Individual entrepreneurs, private businesses, and other independent entities have invested capital in basic and applied research and development. The state's colleges and universities have upgraded their status as leading research and training institutions. Government involvement has consisted of the provision of state and federal funds for the support of R&D, equipment and facilities, student support, faculty salaries, and special institutes and educational programs. In addition, North Carolina has a number of institutions designed to promote scientific and technological advances in all aspects of social and economic activity.

N.C. Board of Science and Technology, and the Governor's Task Force on Science and Technology. Until recently, there was no coordinated effort to integrate the scientific resources within the state and devise a comprehensive approach to technological development and education. While there was significant interaction among the universities and among private businesses, and between academia and industry, no single group served as a focal point for the state's many scientific communities. There was an obvious need for effective use of technological resources of the state at a rate comparable to the increase in the capacity of these resources, and the need for an organization devoted to pulling those resources together for the benefit of the state.

The North Carolina Board of Science and Technology was originally established by legislative action in 1963. The Governor and the General

Assembly, recognizing the need for a strong government role in science and technology policy, reorganized the Board and enhanced its role under new legislation approved in 1979. Functioning as a "nerve center," the Board links state government with public and private research institutions, firms and agencies. The Board consists of 15 members drawn from public and private universities, state and local government, and private industry. The Governor serves as chairman of the Board.

The Board has developed and carried out programs and policies which have led to the creation of the Microelectronics Center, the Biotechnology Center, and the North Carolina School of Science and Mathematics. In addition, the Board has implemented programs designed to improve public understanding of science, to assist state agencies and local governments, to improve the quality of science and mathematics education in the state's elementary and secondary schools, and assist private industries and institutions. The Board has annually provided small research grants to scientists in the state's colleges and universities.

N.C. Biotechnology Center. The North Carolina Biotechnology Center was established in November 1981 to serve as the focal point of the state's efforts to be at the forefront of technological developments in this area. In cooperation with universities, industry, financial institutions, other state government organizations, and the federal government, the Biotechnology Center, has been working to strengthen research and education programs and industrial development in biotechnology in North Carolina.

Experience of the Center to date indicates that industry and the federal government are interested in the potential of North Carolina to contribute to advances in biotechnology. Industry and the federal government have provided support to the Center for the planning of research and education programs that will meet the state's needs in the application of biotechnology to such critical areas as agriculture and forestry, health care, engineering, marine sciences, and new materials production. There is great promise for much larger contributions as these programs are implemented.

The programs are operated within university and industrial facilities, and supported with funds from several sources. State funds are used to purchase equipment for research and teaching programs; industrial funds will provide support for graduate students and postdoctoral fellows engaged in research and teaching. State funds and industrial funds will be combined for the purchase and operation of larger pieces of equipment. The result of the state investment in biotechnology will be additional corporate investment and involvement in the state with the promise of new jobs and tax revenues.

Microelectronics Center of North Carolina. In the Summer of 1981, the North Carolina General Assembly appropriated more than $24 million for the creation of the Microelectronics Center of North Carolina (MCNC). An additional $17 million has been appropriated for fiscal years 83-84 and 84-85. These appropriations are the largest financial commitment ever made by a state in support of this new technology. The Center was created to help North Carolina's universities educate significantly more students in fields related to microelectronics, by providing complete microelectronics research and training facilities.

The Microelectronics Center is a non-profit institution working in close cooperation with five North Carolina universities and the Research Triangle Institute. The universities participating in the Center are North Carolina State University, North Carolina A&T State University, the University of North Carolina at Chapel Hill, the University of North Carolina at Charlotte, and Duke University.

Research and educational programs at the five participating universities span the breadth of microelectronics technology. Combined course offerings among the five schools include Physics, Chemistry, Materials Engineering, Electrical Engineering, Computer Science, and Biomedical Engineering. Important semiconductor and systems research has been underway at the Research Triangle Institute for many years. Through their participation in the Microelectronics Center, the five universities are moving to enhance their microelectronics and semiconductor educational programs.

All five participating schools have opened special microelectronics teaching centers supported by the Microelectronics Center. These centers allow students direct, hands-on experience in design, semiconductor fabrication, and other areas of expertise associated with their curricula. The five participating schools have also begun a unique cooperative arrangement allowing each to use its special expertise to supplement the efforts of the others. Plans for the sharing of faculty and courses and other special inter-university exchanges are well underway.

To support the research and educational programs of the six participating institutions, the Microelectronics Center operates a sophisticated array of design and fabrication equipment at its facilities in the Research Triangle. The central facilities are shared by all six participating institutions and include equipment necessary for semiconductor research and design, fabrication and testing of complete microelectronics systems.

To meet the growing needs of its member institutions, the Microelectronics Center has begun an ambitious program to strenghthen its research and development facilities and services. A modern VLSI circuit design computer system with a complete program library is already in place at the Center's central offices. The computer is tied to color graphics terminals and plotting equipment at each of the five university teaching centers and at the Research Triangle Institute. Through special grants from the Center, small-scale semiconductor fabrication facilities are planned or installed at the four engineering schools participating in the Center.

The Center has begun construction of a new fully equipped semiconductor research and development center in the Research Triangle Park. When finished, the 80,000 square-foot facility will house a complete computer-assisted integrated circuit design laboratory, including the latest computer hardware and state-of-the-art design programs, graphics terminals, plotters, and other related equipment; facilities to support research in the fabrication and behavior of semiconductor devices; and a state-of-the-art fabrication system equipped with mounting and testing equipment. The new research and development facility will also house the Microelectronics Center's administrative and research staffs and provide office and work space for representatives of affiliated industries, visiting faculty, and graduate students conducting research using the Center's facilities.

Until the Microelectronics Center's new home is completed, a state-of-the-art interim fabrication facility at North Carolina State University will meet the fabrication needs of the six participating institutions. Among the equipment now housed at the interim fabrication facility is an ion implantation system, diffusion furnaces, and photolithographic and plasma processing equipment.

Research Triangle Park. The Research Triangle Park was first conceived in 1956, but its sucess did not become certain until 1965, when IBM and the Environmental Protection Agency decided to locate in the Park. The Park covers 5,500 acres of land and is centrally located 12 miles from the University of North Carolina at Chapel Hill, 14 miles from North Carolina State University in Raleigh, and 8 miles from Duke University in Durham.

The Park's development plan provides maximum design flexibility within the requirements of physiography and a major freeway plan. There is no maximum tract size; however, the smallest available site is eight acres. All utilities are available to Park occupants. More than 35 separate research facilities representing government, industry and universities are already established in the Park, employing over 18,000 persons.

The primary objective of the Research Triangle Foundation is to promote the entire resources of the Triangle. Originally financed through contributions from corporations and individual citizens in North Carolina, the Foundation is in essence a trusteeship. The management of the Foundation and its properties (the Foundation is the owner of the Research Triangle Park) is vested in a board of directors composed of university officials and leaders in business and industry from throughout the state. In its early years, the Foundation contributed the original grant and a 160 acre campus to establish the Research Triangle Institute.

N.C. Department of Commerce. Three divisions within the N.C. Department of Commerce share responsibility for directly promoting economic development in North Carolina: Industrial Development, Business Assistance, and International Development.

The Industrial Development Division has lead responsibility for encouraging investments in the North Carolina industrial base, through the recruitment of firms from other states and the expansion, of existing firms. The Division is concerned with the creation of new jobs and the diversification of the industrial base. Division staff provide assistance for larger, new industrial projects locating in the state. In 1982, Commerce Department staff participated in 69 of 144 projects announced for the state -- about 48 percent of the total number of projects. These announcements represent $318 million (78 percent) of the total dollar amount of new investments announced, and 6,557 (73 percent) of the number of new jobs announced.

The Business Assistance Division has lead responsibility for encouraging the start-up of new businesses and providing support for existing small businesses. More than 1,700 inquiries were answered on such topics as how to start a business, marketing, sources of supplies and/or assistance, financing, permits, and training. The Division has been involved with the following activities:

- A Government Procurement Conference was held in Raleigh during May that was attended by some 300 North Carolina businesses.
- Over 400 firms participated in a Buyer/Supplier Conference in Greensboro.
- Workshops on such topics as "How to Start a Business", "Taxes", "Marketing", etc., were either sponsored or co-sponsored.
- Staff support was provided to the Governor's Small Business Advocacy Council.
- The Minority Business Assistance Program has been involved with supporting and developing organizations such as the North Carolina Minority Business Leagues, the Minority Purchasing Councils, and the Business Development Center, to leverage support for minority businesses.
- The Division provided detailed technical assistance concerning labor resources in response to about 1,100 inquiries from Industrial Development staff, industrial clients, local developers, consultants, etc.
- In support of existing business and industry in the state during calendar 1982, the Science and Technology Research Center provided in-depth information reviews on nearly 600 subjects dealing with various aspects of business management, education/training, scientific advances, and technological innovations.
- The Metropolitan Marketing Program developed Economic Atlases on eight urban areas.
- In 1982, a total of 145 communities were designated Communities of Excellence under the Governor's Award program for 1983.
- A major project of the Research Section was to begin implementation of a computerized data base and automated information system.

The International Development Division is concerned with the recruitment of firms from outside the United States, and the expansion of existing international businesses in the state. In 1982, there were 32 new and expanded international investments in North Carolina amounting to $127 million. The total dollar value of $127,325,000 represents an increase of nearly 29 percent over 1981, when $99,075,000 was reported for 34 new and expanded plants.

This Division is also responsible for export development. North Carolina leads the Southeastern United States and ranks eleventh in the nation in the export of manufactured goods. For the year 1980, North Carolina exported $7.7 billion in manufactured goods, an increase of 99 percent from 1977, representing 13.4 percent of the Gross State Product (GSP). Ninety-six thousand North Carolina manufacturing jobs are directly related to exports, representing 11.7 percent of the state's employment in the manufacturing sector. The International Division is staffed by multilingual industry professionals who assist state manufacturers to further expand their overseas markets.

TABLE 1C

STATE INVESTMENTS IN NEW-TECHNOLOGY INITIATIVES FOR NORTH CAROLINA

Initiative	FY 84-85	FY 83-84	FY 82-83	(FY 81-82)
		(Dollars)		
NC Board of Science and Technology	?	178,000	80,000	(390,000)
Governor's Task Force on Science and Technology		100,000	190,000	
Biotechnology Center	500,000	500,000		
		120,000	120,000	
School of Science and Mathematics	3,605,000	3,599,000		
Microelectronics Center of North Carolina	10,045,000	7,255,000		(24,500,000)
University of North Carolina				
UNC-Chapel Hill				
Microelectronics	887,000	887,000		
Computer Science Dept.	9,000,000	1,250,000		
N.C. State University				
Microelectronics	552,000	552,000		
Textile Sch. Improvements	740,000	740,000		
Board of Governors--Research and Teaching in Engineering Science	4,165,300	4,165,300		
Community Colleges				
New Industry Training	6,410,000	6,310,000	2,900,000	
High Priority Programs	1,305,000	1,305,000		
High Technology Training Program (5 institutions)	1,970,000	1,341,000		
Scientific/Technical Equip.		12,400,000		
NC Tech. Development Authority	100,000	75,000		
NC Innovation Research Fund	250,000	225,000		
Incubator Facility Grants	200,000	200,000		
TOTAL	41,373,000	42,855,000		

Chapter Two

POLICYMAKING FOR TECHNOLOGICAL DEVELOPMENT

A growing number of states have created forums -- private, public and quasi-public -- for discussing technological innovation. These forums are about evenly divided between those which emphasize industrial/economic development and those which focus on the development of scientific and technical capabilities.

Full development of North Carolina's social, economic and cultural resources requires the cooperative efforts of government, business, labor, academic institutions, and the public at large. The North Carolina Board of Science and Technology is an example of a state initiative which attempts, on a broad scale, to strengthen interrelationships between all sectors for the benefit of all citizens. Through the Governor's Task Force on Science and Technology, the Board has continued its efforts to build a consensus among leaders in the public and private sectors throughout the state on the need for greater attention to science and technology issues. Through regional forums and ongoing programs and projects, the Task Force is communicating to people at every level that the issues at stake require a partnership approach.

As indicated in the Introduction to this volume, rapid and unplanned technological change can foster considerable confusion and misperception. One problem with technological change is that its impact is not necessarily limited to the actors that initiate the change. For example, the actions of business invariably affect labor and the public at large; similarly, the decisions of education and training institutions determine the quantity and quality of labor available to business. In light of this interdependence of actions and reactions, all interested parties must have the information with which to anticipate the actions of other parties and adapt their own decisions accordingly. The Task Force therefore recommends:

o Public Understanding of Science and Technology

The N.C. Board of Science and Technology should continue its efforts to promote public understanding of science and technology.

The Board should continue its regional forums and/or organize a series of conferences on the role of technological innovation in the achievement of a wide range of social, cultural and economic goals.

The emphasis in these forums should be on providing a link between the activities of state and local government and the concerns of the private sector, and on bringing labor as well as academia into the policy process in a deliberate and systematic way. Most importantly, these forums should provide opportunities for bringing the public into the decisionmaking process.

In addition to promoting public understanding of science and technology, these forums should encourage partnerships in efforts to promote economic development, educational excellence, and other social and cultural goals. These forums should be oriented toward the development of specific strategies and policy recommendations for technological innovation. The product of these forums should provide policy guidance for the Governor, the Legislature, state and local government officials, business, labor, academic and research institutions, and financial institutions on the potential role of technological innovation in social and economic progress. For fiscal year 1984, $20,000 was set aside for the Board's "Public Understanding of Science" project.

In addition to N.C. Board of Science and Technology leadership in promoting public understanding, partnerships, and policy guidance in the achievement of social, cultural and economic goals through technological innovation, there is a general need for the systematic study of technological and social changes in North Carolina.

Problems and disruptive forces can be inherent in societal change. Our social systems are far more complex and harder to understand than our technological systems, and we know little of either. This lack of knowledge, coupled with the speed and magnitude of change expected over the next several decades, are often causes for concern. We cannot stop the pace or reduce the scope of change. But, we can find ways of understanding and directing change to the benefit of society. This task requires the cooperation, participation and partnership of the educational, business, labor and governmental institutions of the state and the public at large. The task requires information gathering, study and debate for both statewide and local action. The Task Force therefore recommends:

- Statewide Studies of Technological and Social Change

  There is a need for systematic and wide-ranging studies of the impact of technological and social change on North Carolina and its people. From this continuing study, strategies and policies would be developed to address some of the state's most pressing social and economic problems.

  Steps should be taken to ensure that the assessment of changes in North Carolina society are not conducted on an ad hoc or only one-time basis. Instead, analyses of North Carolina society should be institutionalized to ensure continuity, comprehensive coverage and indepth analysis. Funding for a special facility to institutionalize this effort may run $50,000 to $100,000 during the planning years, and up to $1,000,000 per year for construction of a building. Funding for an institution could come from a combination of public and private monies.

Private Sector Initiatives

In some states, the private sector -- through chambers of commerce and individual industry leaders -- has assumed a major role in promoting technological innovation, either on an informal or *ad hoc* basis or through the creation of a formal organization. Representatives from the business community, individually or collectively, have advocated or initiated actions that pertain either directly or indirectly to economic growth and development.

Similarly, in North Carolina, the state's emergence as a leader in scientific and technological advance has occurred, in part, because of substantial efforts by the state's business community. Working cooperatively as partners with state and local governments and academic institutions, businesspersons in North Carolina have demonstrated their commitment to strengthening the state's economy.

For the most part, however, these partnerships have focused on individual initiatives to strengthen an existing business through innovation or to aid in the recruitment of a particular firm to the state. There has not been a comprehensive, cooperative effort by the private sector to enhance and utilize the state's science and technology resources for the achievement of broad economic and social goals. A number of business organizations are undoubtedly developing strategies and programs intended to achieve those goals. Yet, the private sector has not made a concerted, sustained effort to determine the role of our scientific and technological resources in meeting statewide goals, and to develop strategies to strengthen those resources.

In North Carolina, the Governor's Management and Development Council is in a favorable position to generate private sector interest in the development and application of new technologies for industrial purposes. The Council is in a leadership position in private industry and can provide the Governor with an industry perspective on technological development. The Task Force therefore recommends:

o Involvement of the Governor's Management and Development Council

The Governor's Management and Development Council should be encouraged to take a special interest in policies and initiatives that will promote technological innovation throughout the North Carolina industrial base.

The Council should consider the development of special initiatives to enlist the ideas, expertise and experience of the small business community and new-technology firms.

The Council might consider the appointment of special committees to recommend new initiatives in: 1) industrial recruitment and expansion, 2) technological innovation in traditional North Carolina industries, and 3) the growth of new and existing small businesses, capitalizing on the opportunities provided by new technologies and organizational innovations. This recommendation would not entail the appropriation of any state monies.

Public Sector Initiatives

In addition to private sector initiatives to promote technological development, there is a need for a clearly-defined, permanent locus within state government for policy and program decisions designed to promote technological innovation. A number of states have proposed or already have in place public or quasi-public institutions responsible for promoting job creation and economic development through technological innovation. Most of these initiatives are specifically designed to promote partnerships between government, business, labor and academia in promoting technological change.

A number of institutions in state government are responsible for promoting economic development. The Economic Development Board is charged with formulating a program for the state's economic development and assisting the Secretary of Commerce in matters relating to existing industry, the recruitment of industry, and expansion of the travel and tourism industries. The State Goals and Policies Board has been involved with the development of new initiatives in small business development.

The Private Industry Council has a number of functions: (a) To increase involvement of the business and industry communities in employment and training activities under CETA, and to increase private sector employment opportunities for economically disadvantaged persons; (b) To serve as an intermediary in assisting the local employment and training structure to become more responsive to the business community; (c) To serve as the business and industry contact point in the local employment and training system, to present the private sector's views and recommendations for making programs more responsive to local employment needs; and (d) To advise and provide direction to the local employment and training system on ways of increasing private sector job placements for persons eligible under Title VII of CETA.

But the problem is that there does not appear to be a systematic, permanent mechanism for the coordination of these forums or the synthesis of ideas and recommendations. Second, the influence of these forums on state economic development policies and actions has been limited. Finally, none of these forums focus specifically on the role of technological innovation in job creation and economic development.

Since the North Carolina Department of Commerce is the lead agency in state government in efforts to promote economic development, the opportunities provided by new technologies and new-technology industries must receive special attention in this agency. It would, therefore, be appropriate for the Commerce Department to seek to adapt industrial recruiting approaches to the special needs and interests of new-technology businesses and to develop special methods for encouraging the start-up of new, technology-based small businesses. Similarly, the Department should develop initiatives designed to encourage technological innovation in traditional North Carolina industries and the expansion of existing technology-based businesses. In particular, there is a need for new initiatives to promote effective working relationships between the Department of Commerce, private industry, the academic and research community, other state agencies, and local government. The Task Force therefore recommends:

- Assistant Secretary for Technology

  An "Assistant Secretary for Technology" should be appointed within the N.C. Department of Commerce.

  The Office of the Assistant Secretary would provide a locus for policy and program development in matters pertaining to technological innovation within the Department of Commerce.

  The Assistant Secretary would be responsible for developing initiatives and methods to promote new technologies, and for coordinating the efforts of Commerce divisions, such as Business Assistance, Industrial Development and International Development, in the promotion of technology-based businesses and technological innovation in existing industries.

The Assistant Secretary should have a good working relationship with the Executive Director of the newly-created N.C. Technological Development Authority. The office of the Assistant Secretary should also have good working relationships with the Microelectronics Center of North Carolina, the North Carolina Biotechnology Center, and other research and academic institutions throughout the state. Implementation of this recommendation could entail additional expenditures of $150,000 to $250,000 per year for salaries and office expenses.

The development of new initiatives within the Department of Commerce, however, only partially addresses the need for coordination in policy development within the public sector. For the potential of technological innovation to be fully realized in efforts to promote economic revitalization and other social goals, the resources and expertise of a number of state agencies must be tapped.

In addition to the Department of Commerce, the following departments should be included in the development of statewide technological innovation policies and programs: Administration, Agriculture, Community Colleges, Office of the Governor (Governor's Science and Public Policy Advisor, N.C. Board of Science and Technology), Human Resources, Labor, Natural Resources and Community Development, Public Instruction, Transportation, State Treasurer, and U.N.C. General Administration. The Task Force therefore recommends:

- Technological Innovation in State Government

  An ongoing and formal "forum" should be created within state government for far-sighted policy and program development in matters pertaining to technological innovation in North Carolina.

  This forum should provide an opportunity for the continuous exchange of ideas and information between state agencies on the appropriate use of scientific and technological advances and organizational innovations to promote a wide range of economic, social and cultural goals. Economic revitalization, public health and safety, educational achievement, hazardous waste management, and governmental efficiency are examples of statewide goals. Implementation of this recommendation could entail additional expenditures to cover administrative costs, but these expenditures should be minimal.

Either the N.C. Board of Science and Technology or the "Productivity Group" of the N.C. Department of Administration could be assigned responsibility for a state government forum on technological innovation.

This chapter has sought to improve the process of policy development and coordination through five organizational innovations designed to:

1. Improve public participation in policy development in matters pertaining to technological innovation in general -- extend the mandate of the N.C. Board of Science and Technology.

2. Improve our ability to understand, anticipate and direct social and technological change -- consider the advantages and limitations of institutionalizing the systematic study of social and technological change in North Carolina.
3. Increase private sector interest and involvement in technological development -- broaden the scope of discussions of the Governor's Management and Development Council.

4. Improve policy development and coordination within the N.C. Department of Commerce in matters pertaining to technological development -- appoint an Assistant Secretary for Technology.

5. Improve policy development and coordination throughout state government in matters pertaining to technological innovation in general -- broaden the mandates of either the N.C. Board of Science and Technology or the "Productivity Group" of the N.C. Department of Administration.

Chapter Three

RECRUITMENT AND EXPANSION OF TECHNOLOGY-BASED FIRMS

The recruitment of manufacturing firms is the primary function of the N.C. Department of Commerce. The Department often takes the lead in efforts to attract new plants to the state, and at other times the Department assists the efforts of local development corporations, chambers of commerce and other community organizations.

The list of manufacturing firms attracted to the state over the past year alone is impressive and includes the following firms with over $10 million in investments: AGA Gas in Wake Forest, Bendix Corporation in Rocky Mount, Glaxo Inc. in Zebulon, Lutravil Company in Durham, Owens-Illinois Inc. in Hamlet, Square D Company in Monroe, Takeda Chemical Industries in the Wilmington area, Toleram Fibers Inc. in Ansonville, the Wall Street Journal in Charlotte, Outboard Marine Corporation in Burnsville, and American Honda Motor Company near Mebane. Recruitment successes over the past year also include firms largely engaged in research and R&D activities: division headquarters for G.E./Intersil Semiconductor; headquarters for ITT's North American Telecommunications; and headquarters for the Semiconductor Research Corporation.

Despite Commerce Department and community efforts and successes in 1982, however, new announcements were only 44 percent of the level of new investments announced in 1981 and only about one-third of the new investment total of $1.25 billion announced in 1980. One problem is that depressed economic conditions in the United States have discouraged corporations from opening new plants or relocating their operations. More importantly, the competition among states for new and relocating plants and headquarters has intensified greatly over the past several years, particularly in technology-based areas.

Considerations in Industrial Recruiting

Announced Investments in Manufacturing. Table 3A, "Investment Trends, 1972-1981," documents the extent to which announced investments -- both new and expanded industries -- have increased since the early 1970s. In a ten-year period, over $13.6 billion in industrial investments were announced in North Carolina, of which 71 percent were announced since 1977. Announced investments increased 144 percent between the periods 1972-76 and 1977-81.

Announced investments increased from one period to the next in all major industry categories, but the relative importance of each industry category has changed markedly, indicating signs of diversification of the state's industrial base (Columns 3 and 6). In the period 1972-76, the leading industries in total announced investments were textiles (23 percent of total announced investments), chemicals (19 percent), paper and allied products (8 percent), food products (7 percent), and tobacco products (5 percent). In the second

TABLE 3A

INVESTMENT TRENDS ($ MILLIONS), 1972-1981

SIC Code & Industry	1972-1986			1977-1981			Change Between 1972-76 & 1977-81			1972-1981		
	Total	% of Total	Rank	Total	% of Total	Rank	Amt. of Change	% of Change	Rank	Total by Ind.	% of Ind. Total	Rank
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
20 Food Prod.	266.3	6.7	4	768.6	7.9	5	502.2	188	9	1,034.9	7.6	5
21 Tobacco Prod.	215.2	5.4	5	994.1	10.3	4	778.9	362	3	1,209.3	8.9	4
22 Textiles	924.4	23.4	1	1,433.3	14.8	1	508.9	55		2,357.8	17.3	1
23 Apparel	47.8	1.2		95.9	1.0		48.0	100	10	143.7	1.0	
24 Lumber & Wood	133.7	3.4		209.2	2.2		75.5	56		343.0	2.5	
25 Furn. & Fix.	135.4	3.4		238.1	2.5		102.7	76		373.5	2.7	
26 Paper & Prod.	326.6	8.3	3	650.9	6.7	6	324.3	99		977.5	7.2	6
27 Print. & Publ.	37.1	.9		135.8	1.4		98.7	266	6	173.0	1.3	
28 Chemicals	755.2	19.1	2	1,276.0	13.2	3	520.8	69		2,031.2	14.9	2
29 Petrol. Prod.	12.6	.3		87.9	.9		75.3	597	2	100.5	.7	
30 Rubber & Plas.	187.8	4.7	6	273.6	2.8	10	85.7	4		461.4	3.4	10
31 Leather Prod.	5.0	.1		7.6	.1		3.1	63		12.5	.1	
32 Stone,Clay,Gls.	157.8	4.0	9	247.6	2.6		89.8	57		405.4	3.0	
33 Pri. Mtls.Prod.	76.7	1.9		257.9	2.7		181.2	236	7	334.6	2.5	
34 Fabr. Metals	124.1	3.1		394.6	4.1	9	270.5	218	8	518.7	3.8	
35 Non-elec. Mach.	168.0	4.2	7	1,330.3	13.8	2	1,162.3	692	1	1,498.3	11.0	3
36 Elec/Electron.	167.1	4.2	8	613.2	6.3	7	446.0	267	5	780.3	5.7	7
37 Transpt. Equip.	149.1	3.8	10	547.2	5.7	8	398.1	267	4	696.3	5.1	8
38 Instruments	36.2	.9		67.7	.7		31.5	87		103.9	.8	
39 Misc.	26.5	.7		23.1	.2		-3.4	-13		49.6	.4	
Total	3,952.9	100.0		9,652.7	100.0		5,699.8	144		13,605.6	100.0	

Source: Based on data from Tables IA and IB, Sectoral Analysis of Announced New and Expanded Industrial Investments, Vol. 5, No. I, N.C. Department of Commerce, April 1982.

period, textiles remained the leading investment category (15 percent), but nonelectrical machinery jumped to the position of second highest investment category (14 percent), followed by chemicals (13 percent), tobacco products (10 percent), and food products (8 percent).

Signs of diversification away from traditional North Carolina industries and towards "higher technology" manufacturing can also be seen in the changes in rank from one period to the next (Columns 4 and 7). Food, chemicals, rubber and plastics, and stone, clay and glass manufacturing all slipped in rank, while fabricated metals, nonelectrical machinery, electric and electronic products, transportation equipment, and even printing and publishing went up in rank.

But rankings only tell part of the story; percentages of total investments (Columns 3 and 6) also indicate diversification of the North Carolina industrial base. Textiles, for example, remained the leading investment category, but as a percent of total announced investments, textiles decreased from 23 percent in 1972-76 to 15 percent in 1977-82. Similarly, the percentages of total investments declined in the apparel, lumber and wood, furniture and fixtures, paper and allied products, chemicals, rubber and plastics, leather, and stone, clay and glass industries. At the same time, the percentages increased in the "high-technology" categories of SIC Codes 34 through 38, with the exception of the instruments industry. The percentage increased in the petroleum products industry as well.

As already indicated, total announced investments increased 144 percent between the two periods (Column 8), with the percentage increases as high as 692 percent in the nonelectrical machinery industry, followed by petroleum products (597 percent), tobacco (362 percent), transportation equipment (267 percent), and electric/electronic products (267 percent).

Table 3B, "Total, New and Expanded Industry Investments, 1977-81," provides further insight into the diversification of the state's industrial base. (Columns 2 through 4 of Table 3B are a duplication of Columns 5 through 7 from Table 3A.) The importance of "new" investments relative to "expansion" investments within each industry category can indicate (1) the relative emphases, and relative successes, in industrial recruitment efforts, and (2) the nature and strength of an existing industry.

The textile industry provides an excellent illustration of these two points. The textile industry ranks first in total investments in the state, comprising 15 percent of total announced industrial investments in 1977-81. But this industry ranks only seventh in "new" announced investments, comprising only five percent of total "new" investments. The investment importance of the textile industry in North Carolina is based, therefore, on announced industrial "expansions." The textile industry ranks first in announced expansions, accounting for 26 percent of all announced expansions. Expansions accounted for 81 percent of total investments in the textile industry in 1977-81.

Other industries where "expansions" were relatively more important than "new" investments (Columns 13 and 14) were stone, clay and glass (98 percent),

TABLE 3B

TOTAL, NEW AND EXPANDED INDUSTRY INVESTMENTS ($ MILLIONS), 1977-1981

Code & Industry	Total			New Investments					Expansion Investments				
	Amt.	%	Rank	Amt.	% of New	Rank of new	% of Total	Rank	Amt.	% of Exp.	Rank of Exp.	% of Total	Rank
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
20 Food Prod.	768.6	7.9	5	642.4	12.51	3	83.6	3	126.2	2.79	10	16.4	
21 Tobacco Prod.	994.1	10.3	4	482.2	9.39	4	48.5		511.8	11.33	3	51.5	9
22 Textiles	1,433.3	14.8	1	247.7	4.92	7	17.3		1,185.7	26.24	1	82.7	3
23 Apparel	95.9	1.0		42.3	.82		44.1		53.6	1.19		55.9	8
24 Lumber & Wood	209.2	2.2		118.0	2.30	10	56.4	10	91.2	2.02		43.6	
25 Furn. & Fix.	238.1	2.5		80.4	1.57		33.7		157.8	3.49		66.2	5
26 Paper & Pro.	650.9	6.7	6	103.4	2.02		15.9		547.4	12.11	2	84.1	2
27 Print. & Pub.	135.8	1.4		85.5	1.67		63.0	7	50.3	1.11		37.0	
28 Chemicals	1,276.0	13.2	3	761.0	14.82	2	59.6	8	515.0	11.40	4	40.4	
29 Petrol. Prod.	87.9	.9		85.5	1.67		97.3	1	2.3	.05		2.7	
30 Rubber & Plas.	237.6	2.8	10	148.8	2.90	9	54.4		124.7	2.76		45.6	10
31 Leather Prod.	7.6	.1		2.7	.05		35.5		4.9	.11		64.5	6
32 Stone, Clay, Gl.	247.6	2.6		58.1	1.13		2.3		189.5	4.19	7	97.6	1
33 Primary Metals	257.9	2.7		79.0	1.54		30.6		178.9	3.96	8	69.4	4
34 Fabri. Metals	394.6	4.1	9	234.5	4.57	8	59.4	9	160.1	3.54	9	40.6	
35 Nonelec. Mach.	1,330.3	13.8	2	1,015.5	19.78	1	76.3	4	314.8	6.97	5	23.7	
36 Elec/Electron.	613.2	6.3	7	413.7	8.06	6	67.5	6	199.4	4.41	6	32.5	
37 Trans. Equip.	547.2	5.7	8	477.4	9.30	5	87.2	2	69.8	1.55		12.8	
38 Instruments	67.7	.7		47.0	.92		69.4	5	20.7	.46		30.6	
39 Misc.	23.1	.2		8.3	.16		36.0		14.8	.33		64.0	7
Total	9,652.7	100.0		5,133.6	100.00		53.2		4,519.1	100.0		46.8	

Source: Based on data from Tables IIA, IIB and IIC, Sectoral Analysis of Announced New and Expanded Industrial Investments, Vol. 5, No. 1, N.C. Department of Commerce, April 1982.

paper and allied products (84 percent), primary metals (69 percent), and furniture and fixtures (66 percent). By comparison, industries where "new" investments were a major portion of total announced investments (Columns 8 and 9) include petroleum products (97 percent), transportation equipment (87 percent), food products (84 percent), nonelectrical machinery (76 percent), and instruments (69 percent).

The annual "Economic Development Report" for 1982 of the N.C. Department of Commerce contains illustrations of data for 1972-82 which verify the preceding analysis of data for 1972-81 (see Table 3C and Figures 3A and 3B).

It should be noted that the preceding analysis of industrial investments does not include the service sector or other non-manufacturing industry categories. This limitation is because the N.C. Department of Commerce does not publish data on non-manufacturing industry categories. The extent of change in the state's economic base can only be fully appreciated by a comparison of the manufacturing and service sectors. The full extent of diversification can be properly assessed only with comparable data on such "high technology" non-manufacturing categories as communications, computer and data processing services, R&D laboratories, and noncommercial educational, scientific and research organizations.

Investment and Job Creation. Table 3D, "Employment in New and Expanding Industries, 1973-82," provides data on the number of investments, number of employees, and dollar amount of investments for a ten-year period. Columns 14 through 16 indicate that, on average, it takes between $53,000 and $58,000 in announced industrial investments to create one job. The implications of this finding can be illustrated with data from 1982.

Last year, a total of 25,500 jobs were lost through plant closings and layoffs. Theoretically, it would have taken $1,402,500,000 (25,500 jobs times an average of $55,000 in investment) in total announced industrial investments in 1982 to replace the lost jobs with new jobs. In fact, however, only 22,107 jobs were attributed to investments in 1982 in new and expanded industries amounting to $1,289,584,000. As a consequence, the state suffered a net loss of 3,393 jobs, and there was an "underinvestment" in industry ranging from $112,916,000 ($1,402,500,000 minus $1,289,584,000) to $186,615,000 (3,393 jobs times $55,000).

The data in Table 3D indicate the amount of investment required per job created in the manufacturing sector -- an average of $55,507 per job. The manufacturing sector is generally considered capital-intensive. The increasing use of new technologies in traditional industries is likely to make manufacturing in North Carolina even more capital-intensive and less labor-intensive. In other words, even larger amounts of investment will be associated with each new job that is created in manufacturing. By comparison, service industries are generally less capital-intensive and more labor-intensive. State and local recruitment officials might, therefore, focus their efforts not only on manufacturing firms but also on those service industries that provide wages that are comparable or better than those in the manufacturing sector.

TABLE 3C

TOTAL, NEW AND EXPANDED INDUSTRIAL INVESTMENTS ($ MILLIONS), 1982

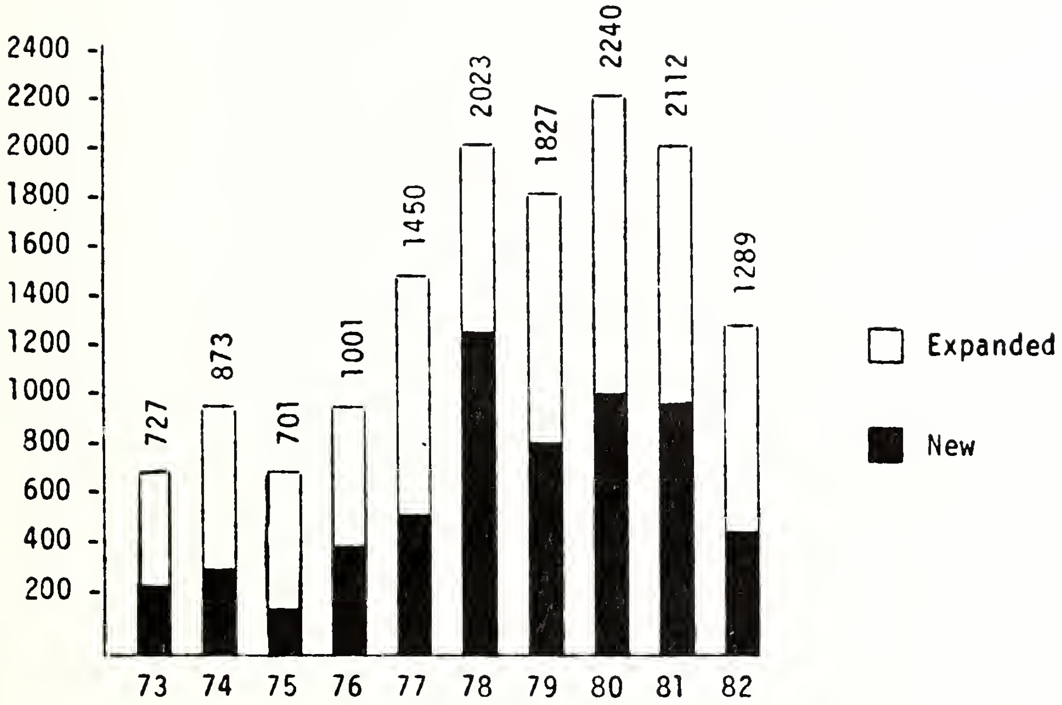
Code & Industry	Total			New					Expansion				
	Amt.	% of Total	Rank	Amt.	% of New	Rank	% of Total SIC	Rank	Amt.	% of Exp.	Rank	% of Total SIC	Rank
20 Food Prod.	31.2	2.4	10	9.1	2.2		29.1		22.1	2.5	8	70.8	9
21 Tobacco Prod.	140.8	10.9	2						140.8	15.9	2	100.0	1
22 Textiles	333.5	25.9	1	53.9	13.2	4	16.2		279.6	31.7	1	83.8	5
23 Apparel	28.4	2.2		6.4	1.6		22.5		22.0	2.5		77.4	8
24 Lumber & Wood	13.0	1.0		1.1	.3		8.2		11.9	1.3	9	91.8	4
25 Furn. & Fixt.	24.6	1.9		5.4	1.3		22.0		19.2	2.2		78.0	7
26 Paper & Allied.	113.4	8.8	5	1.6	.4		1.4		111.7	12.7	3	98.6	3
27 Printing & Pub.	33.8	2.6	7	15.1	3.7	9	44.8	9	18.6	2.1		55.2	
28 Chemicals	112.3	8.7	6	67.7	16.6	2	60.3	2	44.6	5.0	6	39.7	
29 Petroleum Pr.													
30 Rubber & Plast.	40.5	3.1	9	19.7	4.8	7	48.5	8	20.9	2.4	10	51.5	
31 Leather Prod.	3.3	.3							3.3	.4		100.0	1
32 Stone, Clay & Gl.	24.3	1.9		8.9	2.2		36.9	10	15.3	1.7		63.1	10
33 Prim. Metals Pr.	20.6	1.6		10.2	2.5	10	49.4	7	10.4	1.2		50.6	
34 Fabri. Metals Pr.	57.6	4.5	8	29.6	7.3	5	51.5	5	28.0	3.2	7	48.5	
35 Nonelec. Mach.	124.9	9.7	3	61.8	15.2	3	49.5	6	63.1	7.1	4	50.5	
36 Elec./Electro.	124.5	9.7	4	70.6	17.3	1	56.6	4	54.0	6.1	5	43.3	
37 Trans. Equip.	26.9	2.1		15.7	3.9	8	58.4	3	11.2	1.3		41.6	
38 Instruments	30.1	2.3		28.8	7.1	6	95.8	1	1.2	.1		4.2	
39 Misc.	5.8	.4		1.1	.3		19.1		4.7	.5		80.9	6
Total	1,289.7	100.0		406.9	100.0				882.8	100.0			

Source: N.C. Department of Commerce. Economic Development Report 1982.

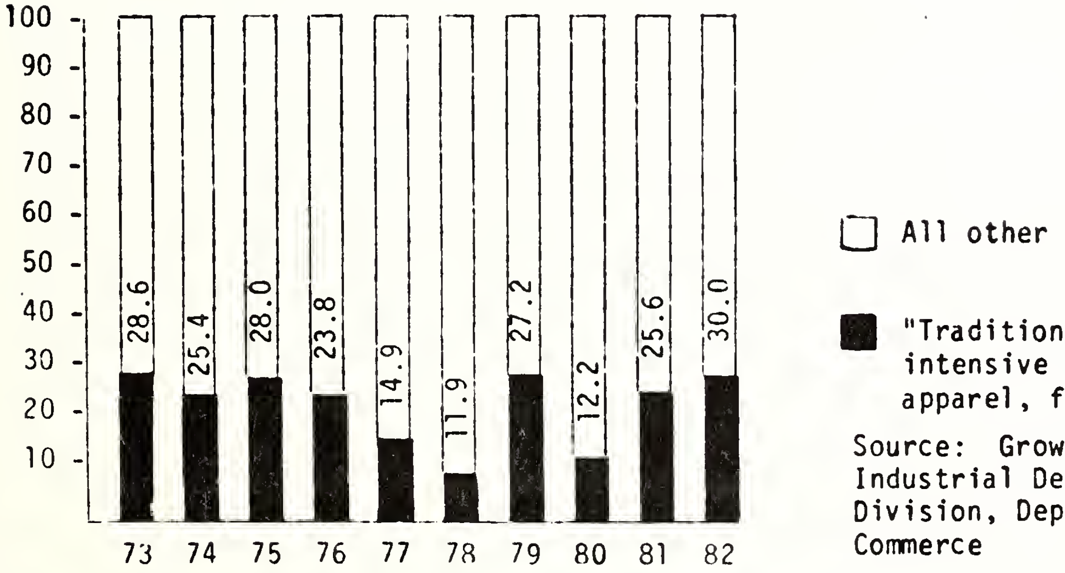
FIGURE 3A

NEW AND EXPANDED
CAPITAL INVESTMENTS ($000,000)
1973 - 1982

Source: Figures 5 and 6,
Economic Development
Report 1982, N.C.
Department of Commerce.



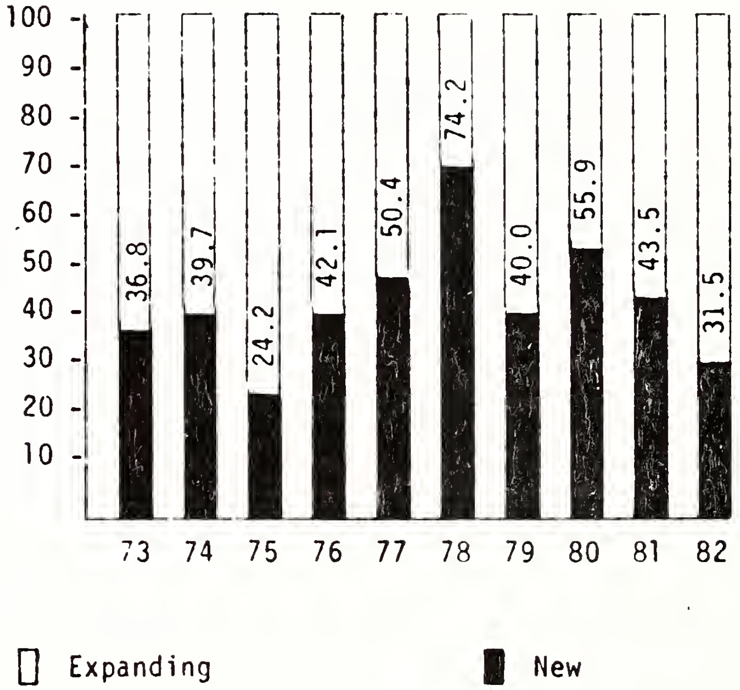
PERCENT OF TOTAL INVESTMENT BY
"TRADITIONAL" INDUSTRIES, 1973 - 1982



Source: Growth Records, Industrial Development Division, Department of Commerce

FIGURE 3B

Source: Figure 7, Economic Development Report 1982, N.C. Department of Commerce.


Percent of Total Investment Represented by New and Expanding Industry, 1973 - 1982

Source: Growth Records, Industrial Development Division, Department of Commerce

TABLE 3D

EMPLOYMENT IN NEW AND EXPANDING INDUSTRIES, 1973-1982

Year	# Investments			# Employees			Emp./# Invest.			Invest.(mil.)			Invest.$/Empl.#		
	New	Exp.	Total	New	Exp.	Total	New	Exp.	Total	New	Exp.	Total	New	Exp.	Total
1973	104	208	312	11,789	10,383	22,172	113	50	71	267.5	459.5	727.1	22,693	44,260	32,793
1974	85	147	232	9,936	8,842	18,778	117	60	81	345.0	526.3	872.3	34,821	59,526	32,793
1975	116	219	335	8,211	10,379	18,590	71	47	55	169.4	531.8	701.3	20,638	51,188	46,454
1976	124	911	1,035	8,093	11,573	19,666	65	13	19	423.5	583.0	1,006.5	52,326	50,377	37,723
1977	163	631	794	12,142	14,557	26,699	74	23	34	730.2	720.0	1,450.2	60,139	49,460	51,179
1978	169	215	384	20,512	9,048	29,560	121	42	77	1,500.7	522.7	2,023.5	73,162	57,775	54,316
1979	192	346	538	16,592	20,282	36,874	86	59	68	730.7	1,096.0	1,826.7	44,039	54,037	68,453
1980	187	280	467	16,856	12,775	29,631	90	46	63	1,252.8	987.4	2,240.2	74,324	77,290	49,538
1981	185	712	897	13,324	19,314	32,638	72	27	36	919.2	1,193.0	2,112.1	68,987	61,767	75,603
1982	144	441	585	9,075	13,032	22,107	63	29	38	406.9	882.8	21,289.5	44,836	67,740	64,714
Tot.	1,469	4,110	5,579	126,530	130,185	256,715	86	32	46	6,746.9	7,502.6	14,249.5	53,323	57,630	55,507

Source: Based on data contained in Figure 4. Economic Development Report 1982. N.C. Department of Commerce.

Table 3E, "Investments and Employees by Industrial Category, 1982," illustrates the relative job creation potential of investments in different types of industry. Column 8 shows that in 1982 the amount of investment resulting, on average, in one job ranges from as low as $9,375 in leather products to as high as $144,033 per job in printing and publishing. Other industry categories with relatively lower investments per job are the apparel, transportation equipment, nonelectrical machinery, and food products industries. By contrast, investments per job are relatively higher in textiles, chemicals, tobacco, and the stone, clay and glass industries. State and local recruitment officials should take into account the amount of investment associated with each job that is created in an industry.

Table 3F, "New, Expanding and Total Industry Investments and Employees, 1982" compares the amounts of investments per job in new industries and in expanded industries. On average, the amount of investment associated with a job in a new industry ($44,836) is less than the amount associated with industry expansions ($67,740). But there are some exceptions to this generalization, where new industry investments are higher than expansion investments per job: chemicals, fabricated metal products, nonelectrical machinery, transportation equipment, and instruments. The Task Force therefore recommends:

- Job Creation

  It is recommended that recruitment efforts of the N.C. Department of Commerce and local organizatons focus on firms that will create substantial numbers of new jobs, as well as serve as a source of investment in the state's economy. Implementation of this recommendation implies new policy perspectives and a reorganization of Commerce Department efforts, but it should not entail any additional expenditures.

By the criteria of both total amount of investment and total number of jobs created, the nonelectrical machinery industry ranks highest, followed by transportation equipment, textiles, apparel and food products. By employment generation criteria alone, textiles ranks highest, followed by nonelectrical machinery, transportation equipment, leather products, and instruments.

Wage Rates. Table 3G, "Average Annual Wages, 3rd Quarter, 1982," provides an overview of wage rates by industry categories. It includes wage levels in all manufacturing industries and compares them to wages in other sectors such as agriculture (services only), mining, construction, services, etc. Annual wages range from as low as $8,892 in the agriculture, forestry and fishery services industry to as high as $23,816 in tobacco manufacturing.

Within the manufacturing sector (Column 3), the highest annual wages are provided in the tobacco, paper and allied products, chemicals, nonelectrical machinery, and electrical equipment industries. The average wage in manufacturing is $16,013; industries below this average include apparel, leather, furniture, lumber, textiles, printing, and food products manufacturing. In general, therefore, "traditional" North Carolina industries offer lower wages than some of the new "high-technology" industries.

TABLE 3E

INVESTMENTS AND EMPLOYEES BY INDUSTRIAL CATEGORY, 1982

SIC Code and Industry	Employees			Investments ($000s)			Ratio	
	No.	/%/	Rank	No.	/%/	Rank	No.	Rank (low-high)
20 Food Products	979	4.4	7	31	2.4	10	31,665	6
21 Tobacco Products	1,280	5.8		141	10.9	2	110,156	
22 Textiles	2,826	12.8	2	333	25.9	1	117,834	
23 Apparel	2,049	9.3	4	28	2.2		13,665	2
24 Lumber and Wood	361	1.6		13	1.0		36,011	8
25 Furniture & Fixture	737	3.3	10	24	1.9		32,564	7
26 Paper & Allied Pro.	290	1.3		113	8.8	5	38,965	10
27 Printing & Publishing	243	1.1		35	2.7	9	144,033	
28 Chemicals	963	4.3	8	112	8.7	6	116,303	
29 Petroleum Products								
30 Rubber & Plastics	864	3.9	9	40	3.1	8	46,296	
31 Leather Products	320	1.4		3	.2		9,375	1
32 Stone, Clay & Gl.	254	1.1		24	1.9		94,488	
33 Prim. Metals Pro.	527	2.4		20	1.5		37,951	9
34 Fabricated Met. Pro.	1,138	5.1	6	58	4.5	7	50,966	
35 Nonelectric Machine	4,629	20.9	1	125	9.7	3	27,004	4
36 Electric/Electronic	2,510	11.3	3	124	9.6	4	49,402	
37 Transp. Equipment	1,249	5.6	5	27	2.1		21,617	3
38 Instruments	677	3.1		30	2.3		44,313	
39 Miscellaneous	211	.9		6	.5		28,436	5
Total	22,107			1,289			58,334	

Source: Based on data from the Economic Development Report 1982.
N.C. Department of Commerce.

TABLE 3F

NEW, EXPANDING AND TOTAL INDUSTRY INVESTMENTS AND EMPLOYEES, 1982

SIC Code and Industry	New				Expansion				Total			
	Empl's.	Invest. ($mil.)	Ratio ($)	Rank	Empl's.	Invest. ($mil.)	Ratio ($)	Rank	Empl's.	Invest. ($mil.)	Ratio ($)	Rank
20 Food Products	216	9.1	44,176	8	763	22.1	29,014	6	979	31.2	31,665	6
21 Tobacco Products					1,280	140.8	110,025		1,280	140.8	110,156	
22 Textiles	987	53.9	54,625		1,839	279.6	152,025		2,826	333.5	117,834	
23 Apparel	939	6.4	6,830	1	1,110	22.0	19,837	5	2,049	28.4	13,665	2
24 Lumber and Wood	40	1.1	26,625	4	321	11.9	37,158	7	361	13.0	36,011	8
25 Furniture and Fixture	280	5.4	19,357	3	457	19.2	41,956	8	737	24.6	32,564	7
26 Paper & Allied	31	1.6	52,419		259	111.7	431,455		290	113.4	38,965	10
27 Printing & Publishing	114	15.1	132,895		129	18.6	144,457		243	33.8	144,033	
28 Chemicals	833	67.7	813,085		130	44.6	342,892		963	112.3	116,303	
29 Petroleum Products												
30 Rubber and Plastics	312	19.7	63,061		552	20.9	378,116		864	40.5	46,296	
31 Leather Products					320	3.3	10,478	1	320	3.3	9,375	1
32 Stone, Clay, Glass	199	9.0	45,025	9	55	15.3	278,964		254	24.3	94,488	
33 Prim. Metal Products	295	10.2	34,447	5	232	10.4	44,840	9	527	20.6	37,951	9
34 Fabr. Metal Products	545	29.6	54,415		593	28.0	47,173	10	1,138	57.6	50,966	
35 Nonelectric Machine	1,168	61.8	52,928	6	3,461	63.1	18,237	4	4,629	124.9	27,004	4
36 Electric/Electronic	2,017	70.6	34,985	7	493	54.0	109,519		2,510	24.5	49,402	
37 Transportation Equip.	393	15.7	39,949	10	856	11.2	13,073	2	1,249	26.9	21,617	3
38 Instruments	595	28.8	48,445	2	82	1.2	15,244	3	677	30.1	44,313	
39 Miscellaneous	111	1.1	9,910		100	4.7	46,700		211	5.8	28,436	5
Total	9,075	406.9	44,836		13,032	882.8	67,740		22,107	1,289.7	58,334	

Source: N.C. Department of Commerce. Economic Development Report 1982.

TABLE 3G

AVERAGE ANNUAL WAGES, THIRD QUARTER, 1982

SIC Code and Industry		Average Annual Wage	Rank within Mfg.	Rank Overall
01-09	Agriculture,* Forestry, Fish	8,892		
10-14	Mining	18,980		
15-17	Construction	13,780		
20	Food and Kindred Pro.	14,664		
21	Tobacco	23,816	1	1
22	Textiles	12,324		
23	Apparel	9,152		
24	Lumber and Wood	11,700		
25	Furniture & Fixture	11,440		
26	Paper & Allied Pro.	21,892	2	2
27	Printing & Publishing	14,300		
28	Chemicals	21,060	3	3
29	Petroleum Products	16,536	10	
30	Rubber & Plastics	18,044	7	10
31	Leather	10,036		
32	Stone, Clay, Glass	16,328		
33	Primary Metals	17,212	8	
34	Fabricated Metals	16,588	9	
35	Nonelectric Machinery	20,332	4	6
36	Electrical/Electronical	18,356	5	7
37	Transportation Equip.	16,276		
38	Instruments	18,252	6	9
39	Miscellaneous	11,960		
40-49	Transp./Comm./Ut.	20,540		4
50-59	Trade	11,180		
60-67	Finance/Insu./R.E.	15,132		
70-89	Services	12,532		
Federal		20,436		5
State		15,652		
Local		12,480		
Total		13,780		

Source: Based on data from the Labor Market Information Division, Employment Security Commission of North Carolina. North Carolina Insured Employment and Wage Payments, Third Quarter 1982.

*Does not include self-employed workers.

Column 5 ranks the manufacturing sector with all other sectors. The average annual wage rate for all sectors is $2,233 less than the average for manufacturing, because average wages in the agriculture, forestry and fishery services industry are very low. It is interesting to note that only mining, transportation, communications and utilities provide wages that are above the average for manufacturing. The data underscore the importance of manufacturing in maintaining and improving the state's income base. But the extent to which manufacturing wages are an improvement over wages in agricultural service and other service sectors varies considerably from one industry to the next. The Task Force therefore recommends:

- Wage Rates

  Industrial recruitment efforts should focus on those firms and industries that will significantly improve wage rates throughout North Carolina. Implementation of this recommendation implies new policy perspectives and a reorganization of current industrial development efforts, but it should not entail additional expenditures.

Regional Dispersion. Table 3H, "Regional Dispersion," provides data on the extent to which industrial development efforts have progressed in all parts of the state. In terms of numbers of projects, amounts of investment and numbers of jobs, the Piedmont region had twice the amount of all industrial announcements than the other two regions in 1982, and this advantage persists in new as well as expanded industry announcements.

Nearly 63 percent of new investments in 1982 occurred in the Piedmont region, a significant increase over the 1981 proportion of 35 percent. By contrast, new investments in the Coastal Plains region dropped from 50 percent in 1981 to 22 percent in 1982, and overall investments declined from 32 percent to 22 percent. The Mountain region has benefitted the least from recent industrial developments efforts, and the Coastal Plains region has fared only slightly better. The Task Force therefore recommends:

- Balanced Growth

  Industrial recruitment efforts should focus, in particular, on job creation and industrial development in the Coastal Plains and Mountain Regions. Implementation of this recommendation implies new policy perspectives and a reorganization of current industrial development efforts, but it should not entail additional expenditures.

The final panel of Table 3H provides data on industrial investments by city size. Fifty-four percent of all investments in 1982 were announced in communities of under 15,000 residents; 67 percent of all new industrial investments were in cities of less than 15,000 residents. These data indicate that industrialization remains relatively unconcentrated and that job opportunities are also being created in rural areas of the state. In other words, job seekers are not necessarily forced to move or commute to urban areas for employment. Excessive congestion is thereby avoided, with important quality of life implications.

TABLE 3H

REGIONAL DISPERSION OF INDUSTRIAL INVESTMENT

Number of Industrial Locations - 1982

Region	Number of Projects			Percent		
	New	Expanded	Total	New	Expanded	Total
Mountain	29	109	139	20.1	24.7	23.8
Piedmont	72	238	310	50.0	54.0	53.0
Coastal	43	94	136	29.9	21.3	23.2
Total	144	441	585	100.0	100.0	100.0

Industrial Investments ($000s) - 1982

Region	Investments			Percent		
	New	Expanded	Total	New	Expanded	Total
Mountain	61,850	135,855	197,705	15.2	15.4	15.3
Piedmont	255,831	497,993	753,824	62.9	56.4	58.4
Coastal	89,210	248,945	338,155	21.9	28.2	26.3
Total	406,891	882,793	1,289,684	100.0	100.0	100.0

Industrial Jobs - 1982

Region	Number of Jobs			Percent		
	New	Expanded	Total	New	Expanded	Total
Mountain	1,787	1,674	3,461	19.7	12.8	15.7
Piedmont	4,340	6,813	11,153	47.8	52.3	50.4
Coastal	2,948	4,545	7,493	32.5	34.9	33.9
Total	9,075	13,032	22,107	100.0	100.0	100.0

Industrial Investment by City Size - 1982

City Size	Investments			Percent		
	New	Expanded	Total	New	Expanded	Total
50,000+	66,341	302,526	368,867	16.3	34.3	28.6
25,00-49,999	49,000	90,559	139,559	12.0	10.2	10.8
15,00-24,999	20,275	65,055	85,330	5.0	7.4	6.6
Subtotal	135,616	458,140	593,756	33.3	51.9	46.0
Below 15,000	271,275	424,653	695,928	66.7	48.1	54.0
Total	406,891	882,793	1,289,684	100.0	100.0	100.0

Source: Figures 8A, 8B, 8C and 8E. Economic Development Report 1982. N.C. Department of Commerce.

Other Factors to be Considered in Recruiting. In addition to the potential amount of investment, number of jobs, wage rate, and regional dispersion of firms, state and local recruitment officials should consider other factors as well in deciding where to concentrate recruiting efforts.

Worker safety and health is an example of an important additional factor. Recruitment officials should consider the safety and health records of corporations or firms interested in relocating or opening a new plant in North Carolina. In those cases where corporations or firms have poor health and safety records, recruitment officials should work with industry officials to improve conditions as a condition for locating or expanding in the state.

Worker health and safety considerations will be particularly important in the emerging high-technology industries, because most of these industries have not been in existence long enough to have generated an adequate data base for analyses. It cannot be taken for granted that high-technology companies will be less hazardous than traditional industries. The Task Force therefore recommends:

- Worker Safety and Health

  Worker safety and health must be considered in industrial development efforts.

  Special steps should be taken to monitor and assess worker health and safety in emerging high-technology industries. Implementation of this recommendation implies new policy perspectives and a reorganization of current industrial development efforts, but it should not entail additional expenditures.

Industrial recruiting officials should also consider the potential effect of a firm on the local environment, such as the nature and volume of wastes that are discharged into the air and water. On the one hand, officials need to consider the additional strain on waste disposal systems and the extent to which local air quality will be affected by an incoming firm. On the other hand, local authorities must consider the additional investments in the infrastructure that must and actually can be made to accommodate incoming industry and retain the quality of life.

Similarly, the impact of incoming industry on local supplies of energy, water, prime farm land and other resources must be considered. Again, it is particularly important that the environmental and resource use implications of "high technology" firms be monitored and assessed, to aid in the decision making process. The Task Force therefore recommends:

- Local Planning

  Industrial development efforts should be developed in concert with local planning efforts.

  Industrial development efforts should reflect a concern with the environmental and resource use implications of new and expanding industries and include an assessment of the additional expenditures that are needed to maintain the quality of life in light of increasing industrialization. Implementation of this recommendation implies new policy perspectives and a reorganization of current industrial development efforts, but it should not entail additional expenditures.

Recruiting High-Technology and Other Innovative Firms

High-technology firms and companies that are considered industry leaders provide both new opportunities and new challenges for industrial development officials at both the state and local levels. They provide opportunities because they are "sunrise" industries, or they are firms that have survived the economic recession and international competition because they have been innovative. Either way, they hold great promise in their ability to create or retain employment opportunities. But they are also a challenge, because the national and international competition for the recruitment of these firms is intense.

Leadership and Partnerships. It has been proposed that an Assistant Secretary for Technology be appointed within the N.C. Department of Commerce. The Assistant Secretary would be responsible for assisting state and local recruitment officials in their efforts to target firms or industries that are particularly suited for a community, taking into account the above-mentioned concerns with levels of investment, job creation, wage rates, occupational health and safety records, and demands on the environment and natural resources.

The Assistant Secretary should also provide leadership in setting statewide policy in the area of high technology. To date, high-technology industrial recruiting efforts in North Carolina have focused largely on microelectronics and biotechnology firms. To maintain and strengthen North Carolina's national reputation as a state that is particularly well-suited for these high-technology industries, a Microelectronics Center of North Carolina and a North Carolina Biotechnology Center have been created to foster industry-university cooperation. Special funding has also been provided for upgrading departments of computer science and schools of engineering at the state's public universities.

The question is whether similar efforts should also be made on behalf of other high-technology industries, such as CAD-CAM (computer-aided-design and manufacture), telecommunications or fiber optics. Some states, such as Michigan, have elected to target their efforts at a limited number of new-technology industries, such as robotics and microelectronics. Others, such as Pennsylvania, have made concerted efforts on behalf of all high-technology industries. Limited financial resources and the competitiveness of other states are likely to necessitate a decision on the issue of targeting in North Carolina. The Task Force therefore recommends:

- Industrial Targeting

  A State policy should be developed on the "targeting" of high-technology industries that are to be fostered, in particular, in North Carolina. Implementation of this recommendation implies new policy perspectives and a reorganization of current industrial development efforts, but it should not entail additional expenditures.

Special Research Centers. As already indicated, an important component of the economic development strategy for North Carolina over the past six years has been the development of two high-technology centers -- the Microelectronics Center of North Carolina (MCNC) and the North Carolina Biotechnology Center (NCBC). Both centers are designed to promote high-technology research and training in the state, but they also serve as a strong attraction for corporations seeking to locate in North Carolina and for entrepeneurs thinking of starting a technology-based business.

It is also hoped that these centers will encourage "spin-offs" from the state's numerous public and private universities, in the sense that faculty are encouraged to develop their research ideas and products for the marketplace. For example, there is tremendous, but as yet unrealized, potential for the state's medical schools to "spin off" related industries. It may be worthwhile for industry analysts and university officials to discuss how this potential for new, fast-growing firms drawing upon the expertise of university faculty could be realized.

Another area where North Carolina appears particularly suited for new industry development is in the marine sciences. North Carolina is blessed with an extensive coastline which has already been developed for recreational, residential and commercial purposes. There is a clear need in the nation to make the progress in marine research that this nation has produced in virtually all other areas of science and technology. Finally, North Carolina is particularly suited for a major initiative in marine sciences because there already exists an extensive and effective institutional base capable of providing needed resources and expertise.

In light of this opportunity, the concept of a "Marine Coastal Research Center" has been discussed by the Cape Fear Area Board on Science and Technology and the Resource Development Committee of the Greater Wilmington Chamber of Commerce. The hope is that this Center will ultimately become the maritime equivalent of the Research Triangle Park.

The major focus of the MCRC would be off-shore activities, such as marine engineering and commerce, deep water staging and marine research, aquaculture, energy and mineral resources, undersea and continental shelf research, coastal erosion and inlet migration, offshore fishing resources, and environmental concerns. Numerous benefits are expected from an orderly, systematic and coordinated approach to the research and development of the state's marine resources. It is hope that the establishment of the MCRC will attract well-paying and environmentally sound industries to the area because of the Center's emphasis on technology and research activities. Finally, it is expected that the proposed Center will strengthen and enhance the programs of existing agencies and institutions, as well as coordinate the development of innovative uses of the state's maritime resources.

In the proposal developed by interested parties in Wilmington, a number of organizations and institutions have been involved with the development of the concept of a Marine Coastal Research Center. In addition to the Chamber of Commerce and the local Board on Science and Technology, other initial participants in the project include: UNC-Wilmington's Department of Marine Science and the Institute for Biomedical Research, Cape Fear Technical

Institute, North Carolina Marine Resources Center, State Ports of Wilmington, North Carolina Department of Natural Resources and Community Development, Wildlife Resource Commission and the Coastal Area Management Program.

The Wilmington area initiative provides an excellent example of the public-private and university-business partnerships that are critical to local economic development and job creation efforts. Other coastal communities as well have the potential for developing initiatives designed to make the best possible and most responsible use of valuable maritime resources. The Task Force therefore recommends:

- Marine Coastal Research Center

  A Marine Coastal Research Center should be established to promote an orderly, systematic and coordinated approach to the research and development of North Carolina's maritime resources and to stimulate economic development and job creation along the coast.

  An assessment should be made to ascertain the most favorable location for such a Center. Implementation of this recommendation could require $50,000 to $100,000 during the planning years, and one to two million dollars per year for the construction of a facility.

Involvement of Statewide Resources in Recruitment. Recruitment efforts in advanced technology areas should focus not only on R&D facilities and corporate headquarters, but also on manufacturing plants at all stages of the production process. It is interesting to note that 59 percent of all jobs in high-technology firms are in businesses primarily engaged in manufacturing. While jobs in high-technology firms represented only 6.36 percent of all jobs in North Carolina in 1982, jobs in high-technology manufacturing firms accounted for 11 percent of all manufacturing jobs. In other words, high-technology firms in North Carolina are at least as manufacturing-oriented as the state's traditional industries. It is particularly critical that new manufacturing jobs be created in North Carolina to provide employment for manufacturing workers that are laid off by traditional industries.

It is also essential that the entire production process be represented in North Carolina, from basic production, to assembly, to marketing, through R&D and corporate headquarters. If all stages of the production process are represented, then workers at all skill levels -- unskilled and semi-skilled production workers, trained technicians, professionals, researchers, managers -- will benefit from the recruitment of technology-based businesses.

Department of Commerce officials were involved with 48 percent of the new industrial projects announced in the state in 1982. At times this involvement was in a leadership capacity, and at other times Commerce staff assisted the efforts of development corporations and other local organizations. Commerce's economic development officers are generally involved with the larger new industrial projects; industrial announcements in which Commerce was involved last year comprised 78 percent of the new investment announced or 72 percent of the number of new jobs announced last year.

The Department of Commerce cooperates not only with local development officials, but also with other individuals outside the agency as well. The

Governor, for example, is involved with numerous recruitment efforts and is considered the state's most prominent recruiter. Other key actors include representatives from the Research Triange Park and the state's two high-technology research centers. The Department of Commerce should consider ways in which representatives from the state's universities and community colleges could be brought into the recruiting process in a more systematic way. Technology-based firms are particularly interested in the availability of trained professionals and technicians, and in sources of new ideas and expertise. It makes sense to involve representatives from institutions of higher education in recruitment efforts. This involvement should improve the success rate of recruitment efforts and, more importantly, early contact with academic institutions could foster cooperative industry-university projects.

The timely involvement of existing technology-based firms would also improve the success of recruitment efforts. Businesses seeking to expand or relocate are often interested in the experience of firms already located in a state. Existing technology-based firms could explain how North Carolina is particularly suited for the development, production and marketing of technology-based products and services. The Task Force therefore recommends:

- Outside Expertise

  Industrial development efforts should include and draw upon the expertise and resources of the state's institutions of higher education and existing firms. Special efforts must be made to make interested firms aware of and familiar with the entire range of important resources in the state.

Fostering the Growth of Existing Technology-Based Firms. As North Carolina seeks to recruit advanced-technology firms and corporations, efforts must also be made to expand the substantial base of innovative firms already located in the state. Data from the N.C. Employment Security Commission indicate that 147,089 people in North Carolina are already employed by "high-technology" firms.

In addition to their direct contributions to the state's economy, existing technology-based companies can be a major source of spin-off ventures, thereby multiplying their potential for economic growth and job creation. In the coming decades, North Carolina's existing technology-based firms must be encouraged to intensify their creative research and development efforts, expand their marketing horizons, and maintain their competitive edge. Many of these firms already have well-established relationships with financiers, suppliers and customers, but they will nevertheless require a supportive climate if they are to continue serving as a source of new jobs in North Carolina. The Task Force therefore recommends:

- Legislative Study Commission

  A Legislative Study Commission should be created to assess the advantages and limitations of modifications in the State Constitution to permit the use of state revenues in providing development support for North Carolina firms. Implementation of this recommendation should necessitate an appropriation of $10,000 to $30,000 for two years of study.

The "public purpose" for which State tax dollars may be used -- as defined in Article B, Sec. 2(1) of the North Carolina Constitution -- has been interpreted somewhat conservatively, so as not to permit the creation of State direct loan (debt or equity financing) or loan guarantee programs. Amending the Constitution would require legislative authorization of a statewide referendum on the issue, followed by approval of an amendment through a statewide vote.

The proposed Legislative Study Commission would focus, in particular, on the need for innovative loan (debt and equity financing) and loan guarantee programs for new businesses, small businesses, minority businesses, and existing larger businesses. The programs would serve as incentives for the relocation of businesses, the expansion and improvement of existing businesses, and the start-up of new businesses.

Loan and loan guarantee programs in North Carolina should promote business development in regions of the state where job creation and economic revitalization are most needed. These programs should place equal emphasis on the development of manufacturing and service firms, and should not be limited to "high-technology" projects. In sum, state loans and loan guarantees should be available for projects which have the potential to create jobs in regions of the state characterized by high unemployment rates (public purpose) and which have a high likelihood of succeeding (sound business investments). Finding and stimulating projects which simultaneously meet both these criteria will require imagination, vigorous efforts, and may also necessitate an innovative investment approach.

The proposed loan and loan guarantee programs could be administered by the N.C. Department of Commerce, the newly-created Technological Development Authority, or a new authority created specifically for this purpose. The authority created for this purpose could be a Type II institution or a state-chartered non-governmental organization. An independent authority could create a revolving loan fund and reinvest the returns from equity arrangements, with the expectation of becoming self-sufficient (no longer dependent on state appropriations) within five to seven years and thereafter capable of repaying the State for its initial capitalization. The Loan Program of the Connecticut Product Development Corporation (CPDC) provides a useful model for the type of institution and set of options that might be developed for North Carolina.

Different loan or loan guarantee options could be created for different types of businesses. For example, financing for small businesses might range from $25,000 to $100,000; support for larger businesses might range from $75,000 to $250,000. The state loan guarantee could be limited to 90 percent of the loan to encourage lenders to make "sound" business investments.

Initial capitalization should come from a number of sources: State and local tax revenues, federal programs (such as the Economic Development Administration and Small Business Administration), foundations, foreign investors, and the private sector. A minimum of two million dollars in initial capitalization would be needed; a ten million dollar fund for a variety of loan and loan guarantee options would be ideal.

To protect the investment, "development agreements" could be made with recipients of loans and loan guarantees, permitting limited oversight of a project in matters pertaining to business management and entrepreneurship. Assistance in identifying and securing alternative sources of financing might also be offered through State loan or loan guarantee programs.

Certain aspects of State loan and loan guarantee programs could outlive their purpose after a period of time. It is hoped that the favorable business climate created as a consequence of direct State involvement with the financial support of businesses will encourage private venture capitalists to invest in North Carolina businesses. As the private sector assumes increasing responsibility for the provision of financial support to North Carolina businesses, State involvement in the provision of loans and loan guarantees should be reassessed. The boundaries of State involvement should be set by the nature and extent of private sector activities; State involvement should complement, but not compete with, private sector initiatives.

Infrastructure Maintenance and Improvement. Data from the N.C. Department of Commerce illustrate the importance of our network of interstate highways to economic development. In 1982, 67 percent of total industrial investments were announced for communities located along interstate highway corridors. This proportion ranges from 66 percent of all industry expansions to as high as 70 percent of all new industrial investments (see Columns 2 through 4, Table 3I, "Interstate Highway Corridors").

But a closer analysis of the data in this table indicates important regional disparities (Columns 6 through 8). Ninety-one percent of all industry expansions and 85 percent of new industrial projects announced in the Piedmont region in 1982 were within the Piedmont Interstate Corridor. These data indicate the importance of the Piedmont Interstate to economic development in the central region of the state.

By contrast, however, only 23 percent of industrial development projects in the Coastal Plains Region and 58 percent of the projects announced in the Mountain Region in 1982 were located along the I-95 and Mountain Interstate corridors, respectively. These data appear to indicate that the interstate highway systems in the Coastal Plains and Mountain regions have been relatively less significant in economic development efforts than the Piedmont Interstate. The problem may be that I-95 and the Mountain Interstate traverse areas that are relatively low in population density. They have, therefore, not adequately served the purpose of linking industrial and population centers throughout the state. Nor have they linked industrial and population centers with important research, academic, social, and cultural resources throughout the state. The Task Force therefore recommends:

- Infrastructure Investments

  The maintenance, improvement and expansion of the state's interstate and state highway network must be a priority in government spending and in efforts to promote economic development and job creation in all regions of the state.

TABLE 3I

LOCATION OF INDUSTRIAL INVESTMENT IN NORTH CAROLINA INTERSTATE AND OTHER LOCATIONS COMPARED, BY REGION

Interstate/Location	New Investment	Expansion Investment	Total Investment
		(million dollars (percent))	
Industrial Investment Along Interstate Corridors			
Mountain Interstate	$ 36.5(9%)	$ 79.3(9%)	$115.8(9%)
Piedmont Interstate	217.7(53%)	456.0(52%)	673.7(52%)
I-95 Corridor	29.6(7%)	47.1(5%)	76.7(6%)
Total Along Corridors	$283.9(70%)	$582.3(66%)	$866.2(67%)
Total Industrial Investment in N.C.	$406.9(100%)	$882.8(100%)	$1,289.6(100%)
Industrial Investment Along Corridors Compared with Other Locations			
Mountain Region	$ 61.8(15%)	$135.8(15%)	$197.7(15%)
Along Corridor	36.5(59%)	79.3(58%)	115.8(59%)
Other Locations	25.3(41%)	56.3(42%)	81.9(41%)
Piedmont Region	255.8(63%)	498.0(56%)	753.8(58%)
Along Corridor	217.8(85%)	456.0(91%)	673.7(89%)
Other Locations	38.1(15%)	42.0(9%)	80.1(11%)
Coastal Plains	89.2(22%)	248.9(28%)	338.1(26%)
Along Corridor	29.6(33%)	47.1(19%)	76.7(23%)
Other Locations	59.6(67%)	201.9(81%)	261.5(77%)
Total Industrial Investment in N.C.	$406.9(32%)	$882.8(68%)	$1,289.7(100%)
Along Corridors	283.9(70%)	582.4(66%)	866.2(67%)
Other Locations	123.0(30%)	300.4(34%)	423.5(33%)

Source: Based on data provided in Figure 3D. Economic Development Report 1982. N.C. Department of Commerce.

In the same manner that extensive highway networks are critical to economic development, so are efficient railway systems and access to air transportation. Other aspects of the infrastructure that are critical to economic development are water and sewage systems and waste treatment and disposal systems. The Task Force therefore recommends:

- Infrastructure Improvements

  State support should be provided for the development and use of scientific and technological breakthroughs in the maintenance, improvement and expansion of the state's infrastructure.

Education, Training and the Quality of Life. When corporations or companies consider communities in different parts of the nation for the location of a new plant or the expansion of an existing facility, the availability of labor is a priority consideration. The quantity, and particularly the quality, of the current and future labor pool are special concerns of technology-based firms.

North Carolina's elementary and secondary schools and institutions of higher education have a number of functions, not the least of which is educating children and adults for citizenship and personal fulfillment. But our educational and academic institutions also have an important role in providing the educated workers, skilled technicians and trained professionals needed by both public and private sector employers. Rapid advances in science and technology over the past several decades have further underscored the need for educational excellence and the need for public investments to improve the quality of our schools, universities, colleges and other training institutions.

The importance of access to a trained labor pool and to the research expertise of university faculty and students cannot be underestimated. But beyond these concerns of direct importance to firms, there are a number of "quality of life" issues that are considered by industry officials. The most important of these include the quality of public schools and playgrounds, the quality and availability of housing, access to a variety of recreation opportunities, availability of cultural and entertainment possibilities, the topography and year-round climate, crime rates, general cleanliness, and the reputation of the community as a nice place to live.

This range of considerations illustrates the interrelatedness of investments in the economy, education, cultural amenities, and social programs. This range of considerations also illustrates the importance of state and local investments.

Chapter Four

TECHNOLOGICAL INNOVATION IN TRADITIONAL NORTH CAROLINA INDUSTRIES

The recruitment of "sunrise" industries to the state and the expansion of existing innovative firms hold great promise for the creation of new jobs in North Carolina and for promoting economic growth. Infusing the state's economic base with technology-intensive industries is an important component of a comprehensive North Carolina strategy for economic revitalization through technological innovation.

But high-technology industry is only one part of the overall strategy; it is not a panacea, and expectations should be tempered by hard evidence. For example, there is evidence nationwide that the number of new jobs actually created through the growth of high-technology industry will fall far short of earlier expectations. Despite their spectacular growth potential, high-technology jobs will comprise only a fraction of U.S. employment by the mid-1990s. Three million workers nationwide are currently employed by high-technology firms -- about three percent of the nation's nonagricultural workforce -- but the expectation is that this proportion will grow to only four percent by 1990. Rapidly rising productivity (output per worker) and increasing automation in high-technology firms will further slow the growth of employment opportunities in this sector.

A second problem is that the limited number of jobs that are created by high-technology industries are likely to be unevenly distributed. Gerhard O. Mensch from Case Western Reserve University summarized this dilemma: "There is not enough high technology to go around. Although there is a whole basketful of new technologies that people are developing, they will be distributed very unevenly. A few places will get the lion's share; most places, barely a ripple." Delaware has the highest concentration of high-technology jobs, with 16.2 percent of its jobs in this area, followed by New Jersey (10.3 percent), California (9.5 percent), and Arizona (9.0 percent). California has the largest number of high-technology jobs with 933,100 jobs followed by New York (493,400), Texas (372,000), and New Jersey (316,800).

Most importantly, the number of jobs in high-tech firms will not be sufficient to offset job losses from traditional industries. Data Resources Inc. has predicted that the number if high-technology jobs created over the next decade will be 750,000 to one million jobs nationwide, ten times the number of jobs expected to be created in the rest of industry. But these jobs in high-technology firms are only a third of the three million jobs lost in manufacturing -- particularly the automotive, rubber, steel and textile industries -- over the past three years alone.

The task of creating -- and retaining -- more jobs than are being lost is particularly critical in North Carolina where manufacturing has been a major source of jobs, income and economic growth over the past century. There are already signs of a declining manufacturing base in North Carolina. The proportion of jobs in manufacturing declined to about 34 percent (785,038 jobs) in 1983 from a peak of 42.6 percent (822,021 jobs) in 1980, and the prognosis is for further loses in manufacturing jobs over the coming decade, particularly in certain key industries.

Creating and retaining manufacturing jobs that offer good wages and the potential for upward mobility is crucial if North Carolina is to provide jobs in the future for unskilled and semi-skilled workers and trained technicians. Challenging and rewarding jobs in manufacturing must be provided as an alternative to low-wage, low-opportunity service sector jobs and as a guard against unemployment rates expected to hover around eight to nine percent even after the national economy has recovered.

This chapter discusses the potential and limits of technological innovation in the creation and retention of jobs in manufacturing. The textile industry provides an illustration of the impact -- both positive and negative -- of scientific and technical advance on manufacturing. This chapter also discusses technological innovation in another key traditional North Carolina industry -- agriculture and agribusiness.

Changes in North Carolina's Manufacturing Base

Manufacturing has had special importance in North Carolina because it has been the principal means by which the state and regions of the state have changed from subsistence agriculture to modern economies. Manufacturing has been a leading source of employment and an important means of raising per capita income. Although North Carolina is only the tenth most populous state, it is fifth in the nation in the number and first in the nation in the percent of industrial workers.

Table 4A, "Manufacturing in North Carolina," shows the composition of the manufacturing sector as of June 1983. The textile and apparel industries provide the bulk of manufacturing jobs in the state, comprising 39 percent of manufacturing employment and 13 percent of all employment. The furniture and fixtures industry provides an additional ten percent of manufacturing jobs. Together, these three industries comprise almost 50 percent of manufacturing employment and 17 percent of all employment in the state.

Manufacturing employment is well-dispersed throughout the state, which explains North Carolina's low degree of urbanization despite high levels of industrialization (see Figure 4A, SIC 20-39, Total Manufacturing Employment). There is considerable geographic dispersion in the industrial categories of food (Figure 4B, SIC 20), textile mill products (Figure 4C, SIC 22), apparel (Figure 4D, SIC 23), lumber and wood products (Figure 4E, SIC 24), printing (Figure 4F, SIC 27), and stone, glass and clay (Figure 4G, SIC 32). But there are significant concentrations of tobacco manufacturers in the Coastal Plains Region and the Northern Piedmont (Figure 4H, SIC 21). Similarly, furniture and fixtures manufacturing is concentrated in the Lenoir-Hickory area and near Thomasville and High Point (Figure 4I, SIC 25).

Relative concentrations in manufacturing employment have important implications for efforts to promote job creation and economic growth in all parts of the state. As a consequence, two alarming trends have already emerged in North Carolina over the past several years. One trend is the relative concentration in the Research Triangle, Piedmont Triad and Metrolina

TABLE 4A

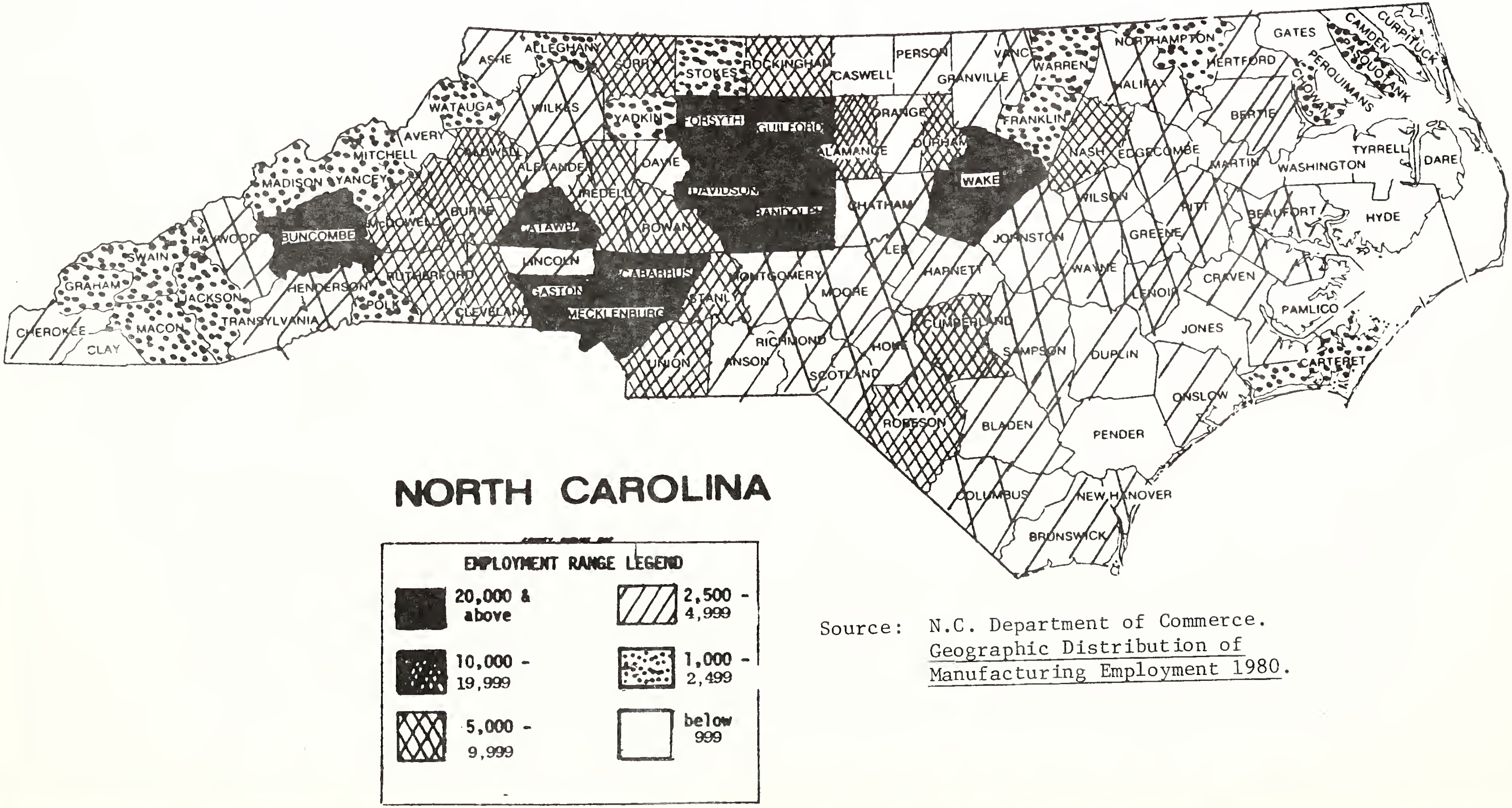
MANUFACTURING IN NORTH CAROLINA
(SIC Codes 20-39)

SIC Code and Industry	Number of Firms No.	Number of Firms % Manuf.	Average Ann. Employment No.	Average Ann. Employment % Manuf.
20 Food and Kindred Products	664	6.3	44,043	5.6
21 Tobacco Manufacturers	32	.3	25,206	3.2
22 Textile Mill Products	1,358	12.9	225,077	28.6
23 Apparel and Other Similar Products	847	8.1	84,148	10.7
24 Lumber and Wood Products	1,983	18.9	31,411	4.0
25 Furniture and Fixtures	704	6.7	79,319	10.1
26 Paper and Allied Products	192	1.8	22,070	2.8
27 Printing, Publishing	1,104	10.5	21,345	2.7
28 Chemicals and Allied Products	305	2.9	38,672	4.9
29 Petroleum Refining Industries	20	.2	669	.1
30 Rubber and Misc. Plastics	306	2.9	25,637	3.2
31 Leather and Leather Products	54	.5	6,096	.8
32 Stone, Clay, Glass, Concrete	410	3.9	16,125	2.1
33 Primary Metal Ind.	102	1.0	8,832	1.1
34 Fabricated Metal Prod., Except Machinery, Transportation Equipment	572	5.5	23,498	2.9
35 Non-Electrical Machinery	1,030	9.8	50,976	6.5
36 Electric and Electronic Equip.	258	2.5	52,062	6.6
37 Transportation Equipment	204	1.9	15,615	2.0
38 Instruments and Related Pro.	108	1.0	9,499	1.2
39 Miscellaneous Manu. Ind.	199	1.9	4,738	.6
Manufacturing TOTAL	10,452	100.00	785,038	100.00
Industries TOTAL	126,991		2,312,552	

FIGURE 4A

SIC 20 - 39

TOTAL MANUFACTURING EMPLOYMENT

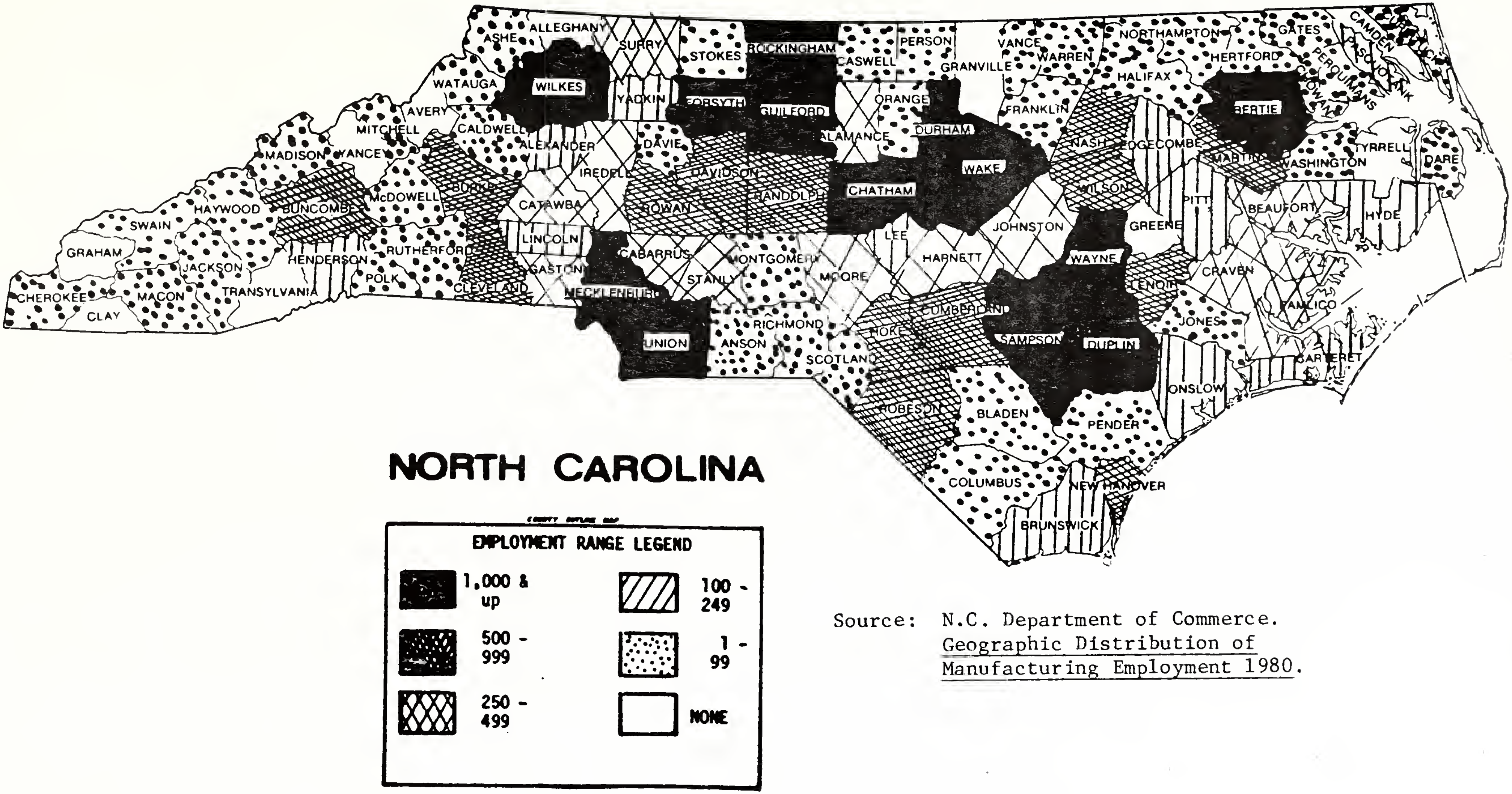


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 4B

20

FOOD PRODUCTS

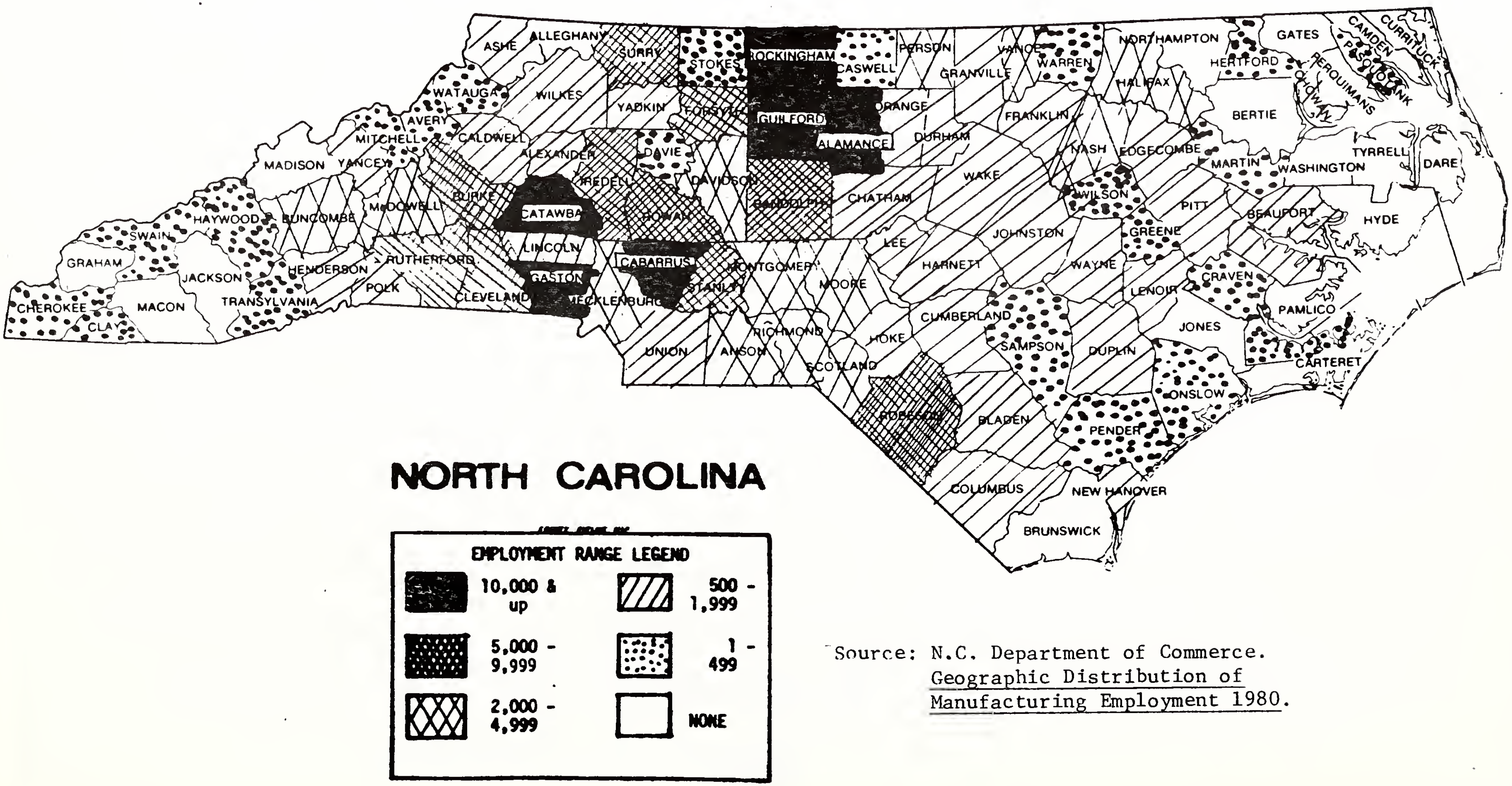


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 4C

22

TEXTILE MILL PRODUCTS

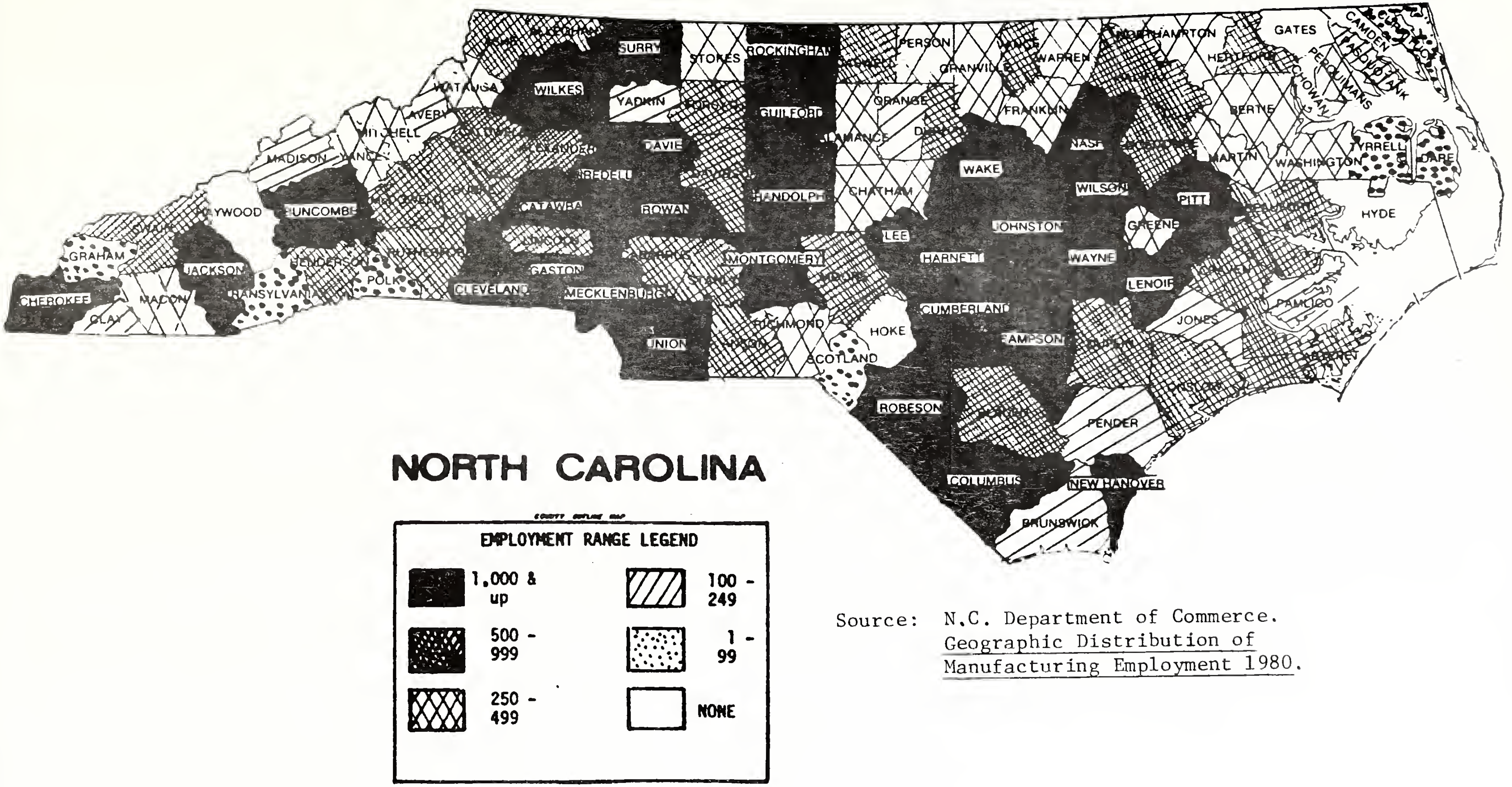


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 4D

23

APPAREL

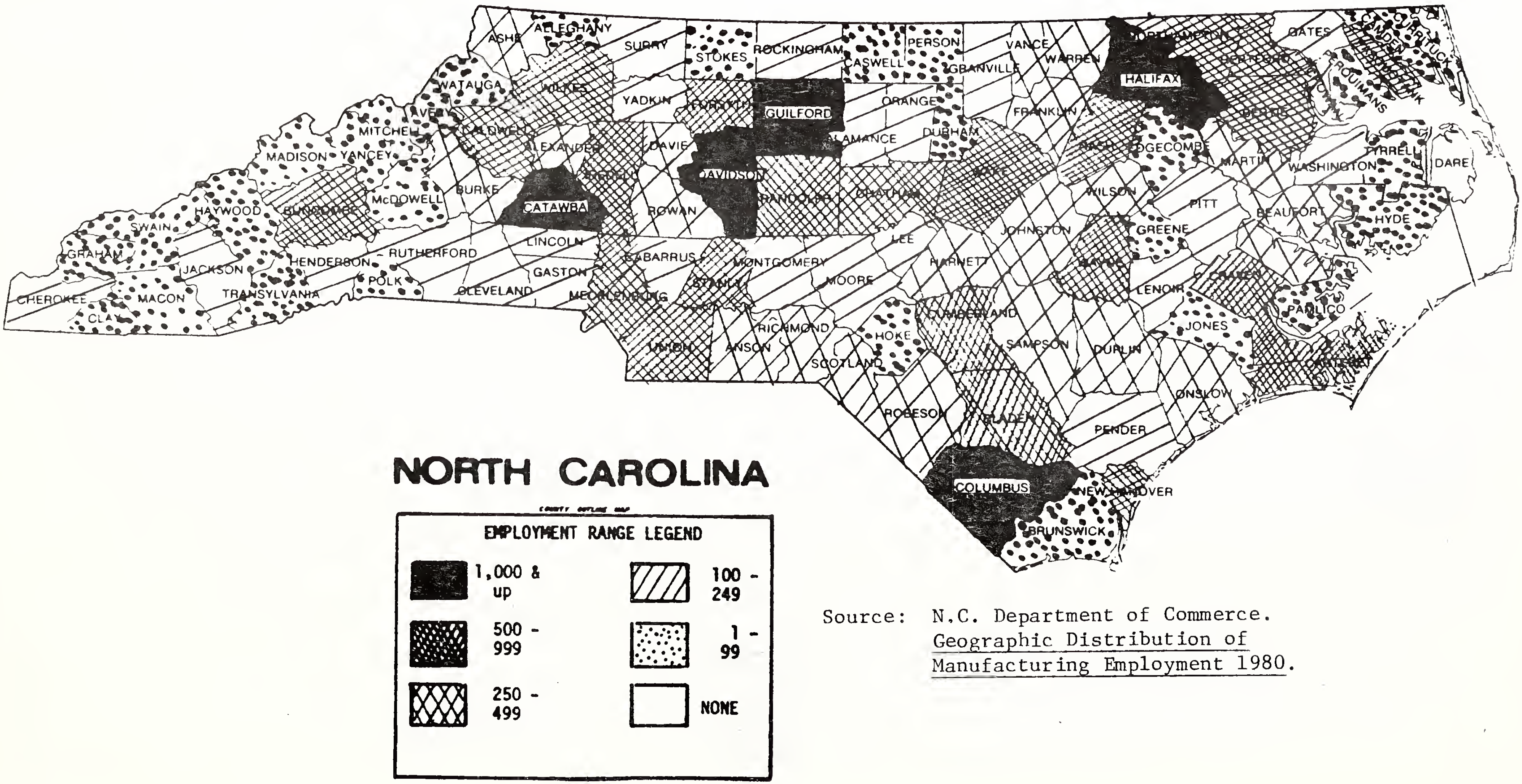


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 4E

24

LUMBER AND WOOD PRODUCTS

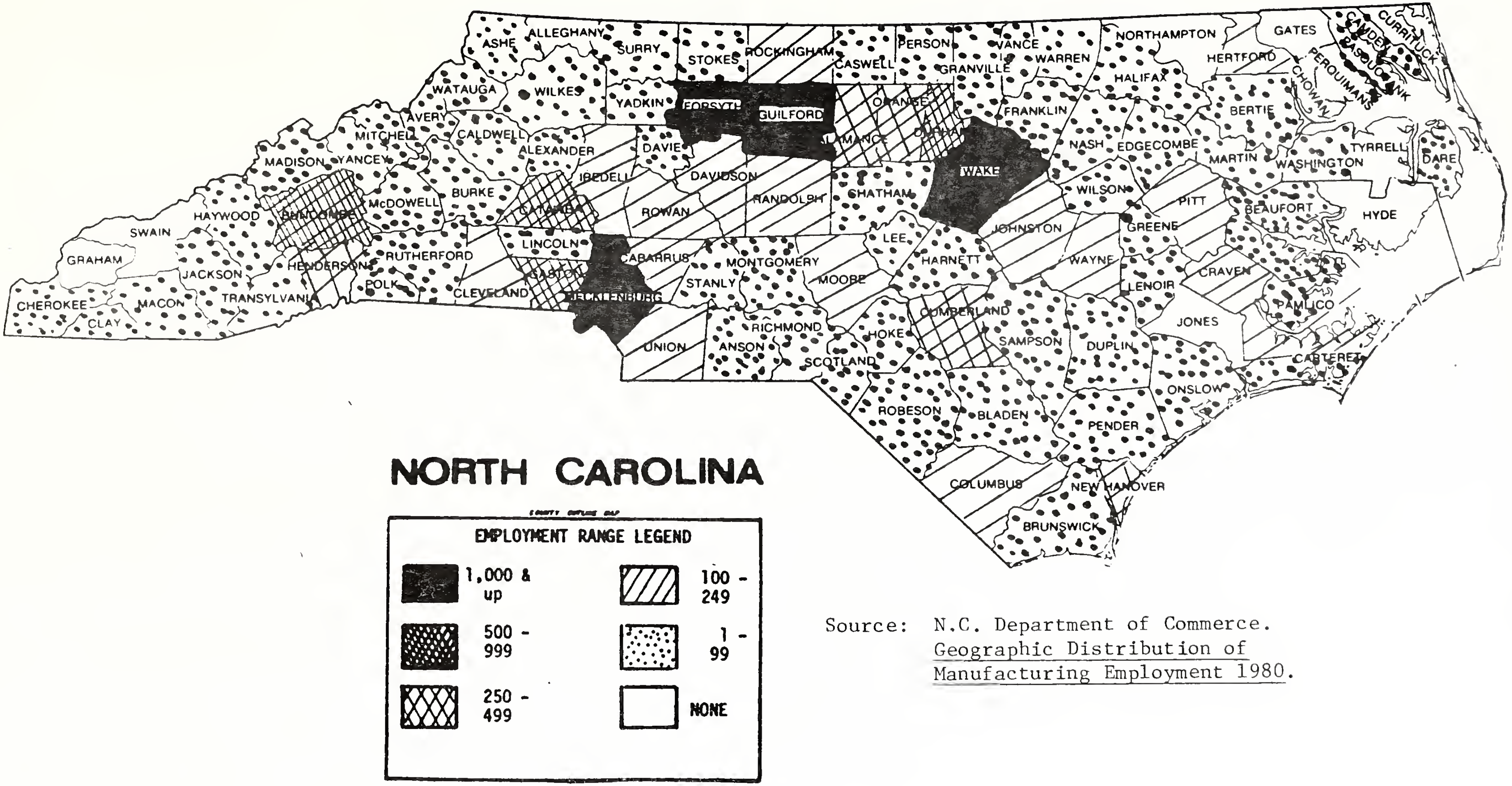


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 4F

27

PRINTING AND PUBLISHING

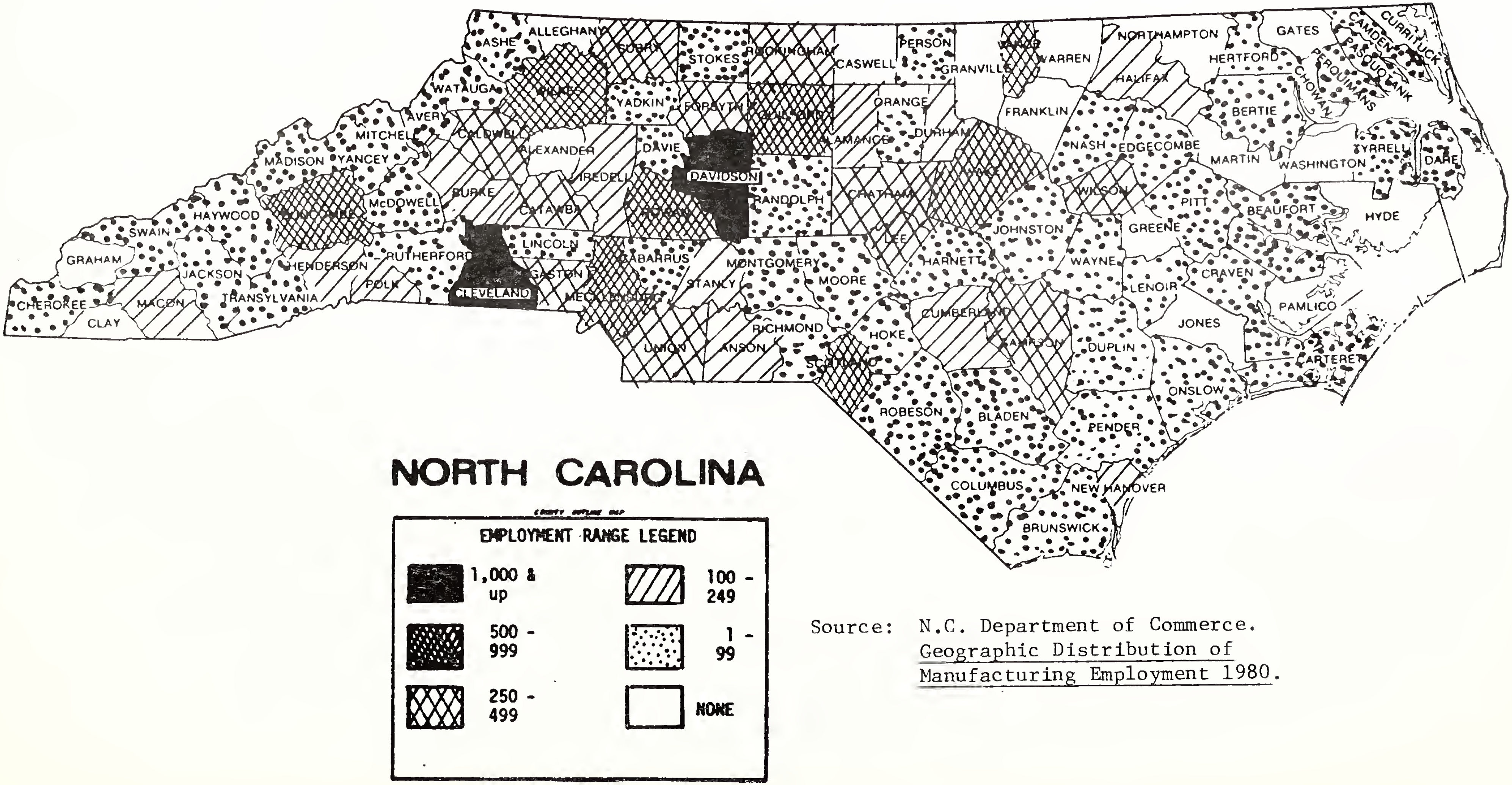


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 4G

32

STONE CLAY AND GLASS

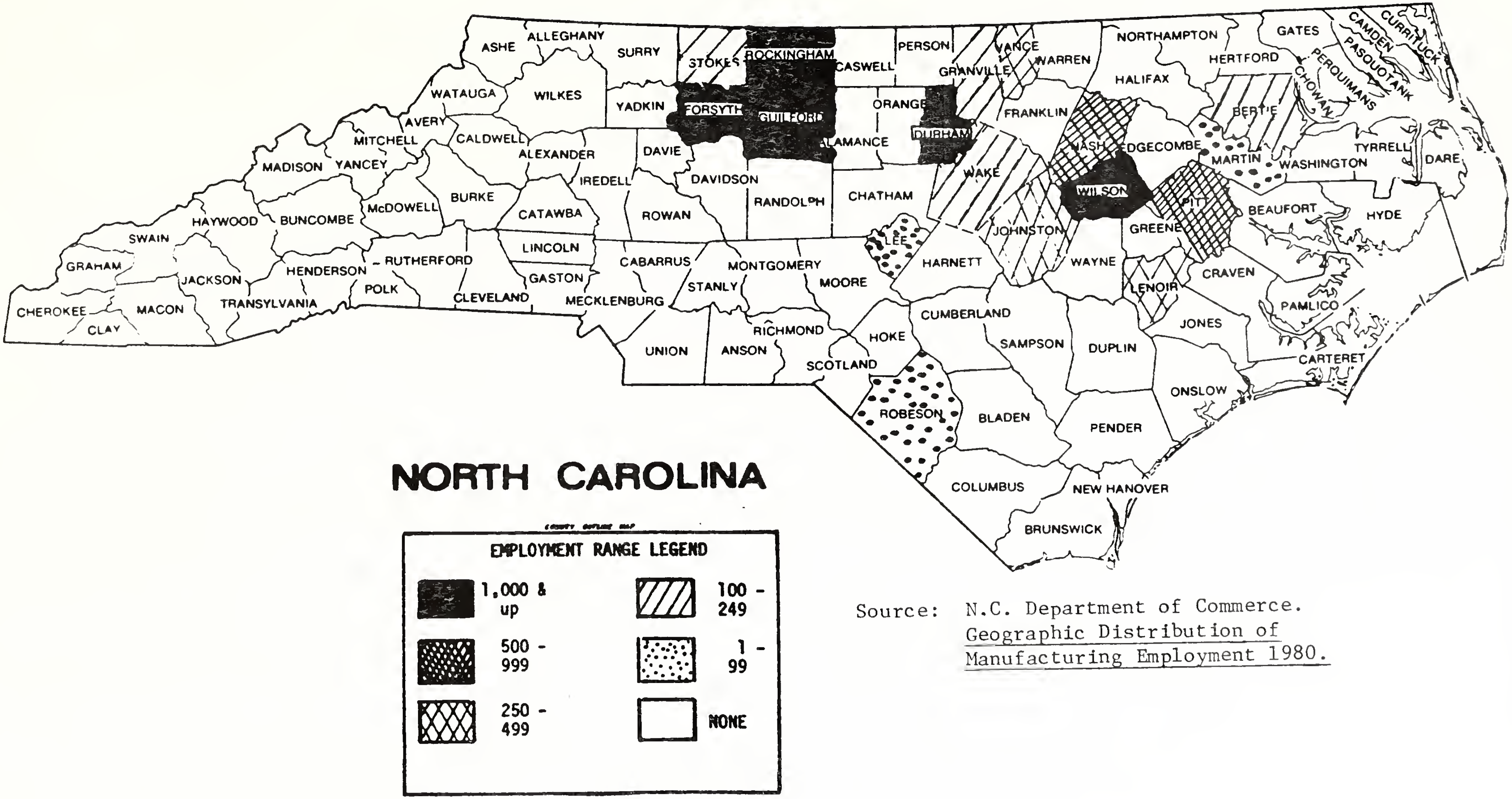


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 4H

21

TOBACCO MANUFACTURERS

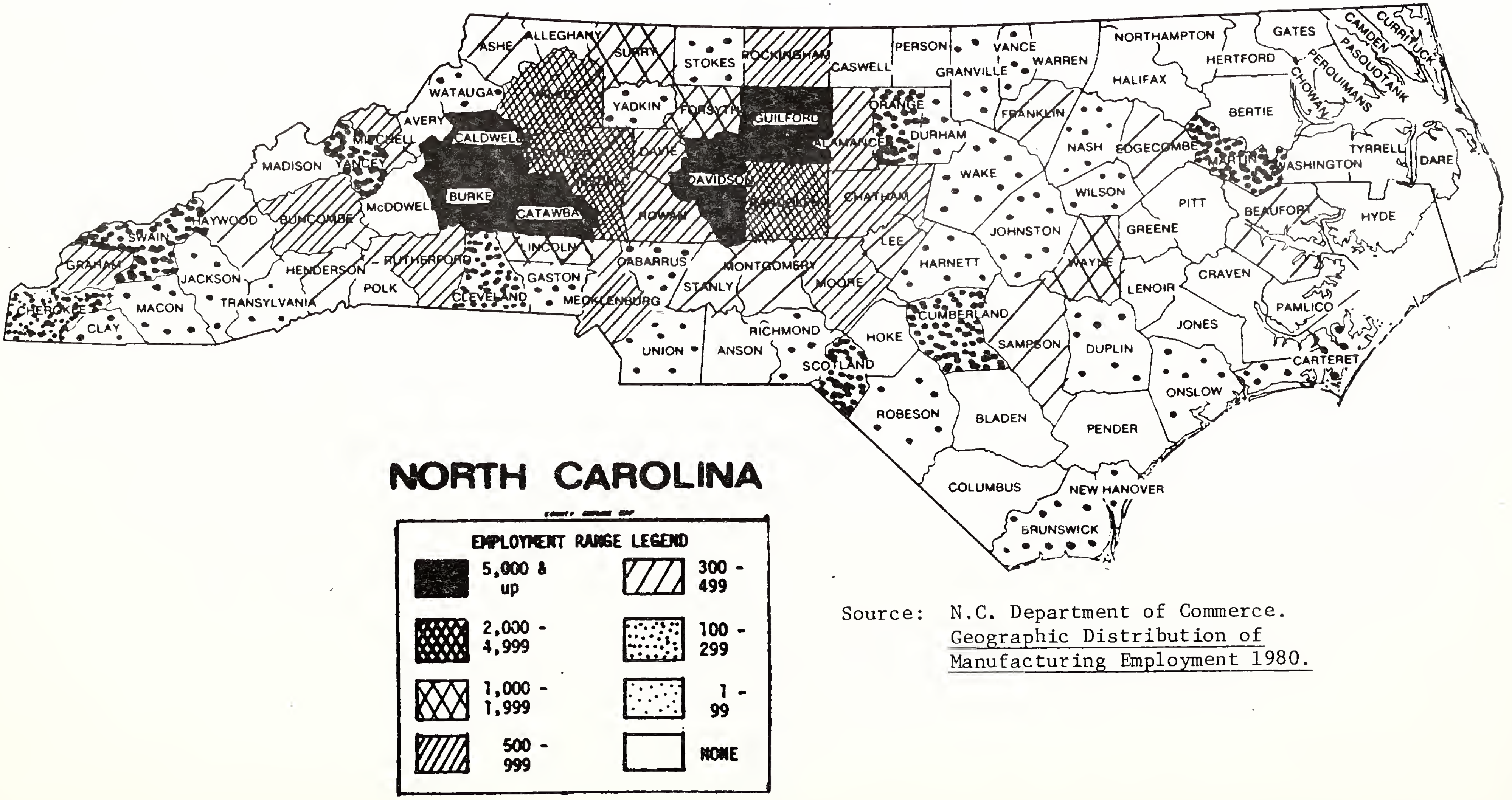


Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

FIGURE 41

25

FURNITURE AND FIXTURES



Source: N.C. Department of Commerce. Geographic Distribution of Manufacturing Employment 1980.

regions of employment opportunities -- including manufacturing jobs -- associated with an expanding high-technology sector. North Carolina's strategy for economic growth must include an emphasis on the dispersion of high-technology job opportunities throughout the state. Similarly, efforts to create and develop new businesses should focus on job creation in all regions of the state.

The second alarming trend is the loss of jobs in certain industrial sectors that have and will affect employment opportunities more seriously in some regions of the state than in other regions. Table 4B summarizes data on "Manufacturing Plant Closings and Permanent Layoffs" since 1978. The trend has been consistently upward in the number of permanent layoffs. Table 4C provides an overview of "Plant Closings and Permanent Layoffs by Manufacturing Categories" over the past five years. Textiles leads in the number of plants that have closed or permanently laid off workers, followed by the apparel, electric machinery, and furniture industries.

TABLE 4B

MANUFACTURING PLANT CLOSINGS AND PERMANENT LAYOFFS

1978-1982

Year	Plant Closings		Permanent Layoffs		Total	
	No. of Plants	No. of Jobs	No. of Plants	No. of Jobs	No. of Plants	No. of Jobs
1982	102	12,660	157	12,836	259	25,496
1981	31	4,880	66	7,850	97	12,730
1980	49	6,700	34	2,835	83	9,535
1979	30	4,760	14	1,320	44	6,080
1978	32	7,060	16	2,290	48	9,350
Total	244	36,060	287	27,131	531	63,191

Source: N.C. Department of Commerce, 1983

Singly, the two trends of employment creation in some regions and job losses in other regions have serious implications for local economies. In combination, they illustrate the magnitude of the challenge of creating jobs and promoting economic growth over the next several decades. In 1982, 102 plants closed and an additional 157 plants announced permanent layoffs, for a total loss of 25,500 jobs. At the same time, industrial development efforts resulted in 22,100 new jobs. The net effect was a loss of 3,400 jobs in 1982.

TABLE 4C

PLANT CLOSINGS/PERMANENT LAYOFFS BY MANUFACTURING CATEGORIES 1978-1982

Industry	1982	1981	1980	1979	1978	Total
Manufacturing TOTAL	259	97	83	44	47	530
Durable Goods TOTAL	136	56	33	11	7	243
Lumber-Wood	10	8	2	0	3	23
Furniture	21	5	10	3	0	39
Stone-Clay-Glass	15	8	1	1	0	25
Primary Metals	6	3	1	0	0	10
Fabricated Metals	15	6	1	1	0	23
Nonelectrical Machinery	26	3	2	1	0	32
Electrical Machinery	22	8	9	1	4	44
Transportation Equipment	14	6	3	2	0	25
Instruments	2	3	2	1	0	8
Miscellaneous Manufacturing	5	1	2	1	0	9
Nondurable Goods Total	123	41	50	33	40	287
Food	6	2	2	2	3	15
Tobacco Manufacturing	1	0	1	1	1	4
Textiles	51	19	32	17	25	144
Apparel	24	6	7	9	7	53
Paper Products	7	3	2	1	3	16
Print-Publishing	1	0	1	0	0	2
Chemicals	19	9	3	2	0	33
Petroleum Products	10	1	1	0	0	12
Rubber Products	4	1	1	1	1	8

Source: N.C. Department of Commerce, 1983

The Textile Industry: A Case Study

As of January 1983, there were 288,000 unemployed persons in North Carolina, of which 120,000 (48 percent) were dislocated because of the recession, technical advances, foreign competition, and the state's changing industrial base. It is still unclear whether most, or even any, of these workers will be rehired by the industries from which they were dismissed.

A recent meeting of current and former chief executive officers of the nation's largest companies brought to light the fact that these companies were not planning to rehire most of the workers they had laid off, no matter how strongly the economy recovers. During the recession, these companies had turned to increased mechanization and modernization of plant and equipment to decrease production costs and remain internationally competitive. Having reduced their dependence on production workers, these companies now have little reason or incentive to rehire. Willard C. Butcher, Chairman of Chase Manhattan Bank, summarized the choice faced by industry: "...let's say we won't modernize and raise our productivity. Then you'll have no employment at all." The choice appears to be between modernizing and laying off large numbers of workers, or not modernizing and closing plants for an even greater loss of jobs.

The textile industry in North Carolina illustrates this dilemma. Over the past ten years 63,000 textile workers in the state lost their jobs. Since March 1982 alone over 10,000 textile workers have been laid off, and estimates of the proportion of workers to be rehired by the industry range from only 70 percent to as low as 40 percent.

Support for Research and Development. Since the mid-1970s, the textile industry in North Carolina has demonstrated an increasing willingness to modernize the production process. Some of the modernization has come from the ground up; the $55 million new Burlington Industries plant in Erwin is a national showcase for state-of-the-art textile manufacturing. New technologies have been used to streamline manufacturing processes, increase efficiency, improve quality, and provide a better work environment. The plant employs 1,600 workers whose payrolls add $24.6 million to the Harnett County economy.

The use of new technologies, however, need not be restricted to entirely new plants. Many existing facilities can be retrofitted with new equipment. Advances in textiles technology over the past 20 years have revolutionized spinning equipment, texturizing machinery, and the processes for pattern grading, marker planning and cutting.

New technologies have also improved the quality of textile products. Quality control is particularly critical if the U.S. textile industry is to remain internationally competitive. The industry must not only catch mistakes in production, but also eliminate the potential for mistakes. The U.S. textile industry produces about 20,000 defective parts per million compared to only 1,000 ppm in Japan. To retain or regain our competitive position, the standard for quality must be higher in the U.S. textile industry than in other countries.

The Japanese have achieved this remarkable level of quality and productivity largely through the application of statistical quality control methods. In Japan, statistical methods and techniques are understood and used by a large number of operators and foremen who are elementary and secondary school graduates. By contrast, in the United States we consider ourselves fortunate when managers that have graduated from universities with technical degrees show an understanding of the theory and principles of statistics, and use those principles in their industrial work.

Automation -- the use of robots, sophisticated manufacturing equipment, computers, process control, and automated materials control -- has improved productivity and quality. But new technologies can also improve the efficiency of energy use. The electrical cogeneration facility at the Erwin plant has greatly improved energy management; a coal-fired boiler creates two sources of power, electricity and low pressure steam for processing.

Scientific and technical advances have also been used to improve waste management; the waste water treatment facility at the Erwin plant returns water to the Cape Fear River cleaner than the water originally taken from the river. Investments in opening equipment, chute-feed carding, open-end spinning, pneumatic waste recovery equipment, and filtration systems have reduced cotton dust levels in plants. Data processing, telecommunications and other innovations in plant management and office administration have also been important in the overall modernization of the textile industry.

It is clear that new technologies can and should be used not only to increase productivity, but also to improve product quality, waste and energy management, and occupational safety and health. To the extent that new technologies have already been invented and new management practices have been tested, there should be increased cooperation within the textile industry -- not only in North Carolina but nationwide -- in the sharing of information and experiences among firms. The Task Force therefore recommends:

o North Carolina Technological Development Fund

A "North Carolina Technological Development Fund" should be created to encourage and support industrywide studies of the state of technology in North Carolina industries.

The Fund would provide financial support for a study team to conduct assessments of the state of technology in such key industries as textiles, apparel, furniture, agriculture, and chemicals. Funding per industrywide study would average about $150,000 with funding coming from a combination of public and private monies. The newly-created N.C. Technological Development Authority, the N.C. Board of Science and Technology, or the N.C. Department of Commerce could be responsible for administering this effort.

The state of technology in North Carolina industry could be compared to that of other states and other countries. Obstacles to technological innovation would be identified, as well as opportunities for research, R&D, technology transfer, and the application of research findings. The end product of each assessment would be a blueprint for a new generation of industries in North Carolina. It is hoped that a precedent can thereby be set for intrastate, industrywide cooperation in research, R&D and technology transfer.

Many new technologies have already been developed and evaluated within and outside North Carolina. But many more scientific and technical advances remain to be discovered. The School of Textiles at N.C. State University has played an important role in research and R&D efforts that have promoted innovation in the state's textile industry. But the State appropriates about $650,000 a year for textile research at the NCSU School of Textiles.

There are also opportunities for cooperation between the NCSU School of Textiles and other research institutions, such as the Microelectronics Center of North Carolina (MCNC). Plans are already underway for the establishment of a "Textile and Apparel Microelectronics and Robotics Application Program" on the campus of N.C. State University. Transfers of money within the 1983-84 budget of the University have provided $1.33 million in funding for the first two years. Of this sum $590,000 will be spent on continuing costs (ongoing operations) and $150,000 on renovations and the construction of facilities at the School of Textiles. The School of Textiles will administer the program in cooperation with the NCSU School of Engineering and the Microelectronics Center.

In addition to the School of Textiles, many of the state's public and private universities have research and training programs in other areas of histroric importance to the North Carolina economy. For example, support for the state's agricultural economy is provided through such programs as East Carolina University's Institute for Historical Research in Tobacco; North Carolina State University's School of Agriculture and Life Sciences and its newly-established School of Veterinary Medicine; and the North Carolina Agricultural Research Service which is a cooperative effort of North Carolina A&T State University, North Carolina State University, and UNC-Greensboro. Support for the forestry industry is provided through research conducted at North Carolina State University's Hodges Wood Products Laboratory, Industry Research Programs in Forestry, and the Southern Forest Research Center. Research of relevance to the state's furniture industry is conducted at North Carolina State University's Furniture Manufacturing and Management Program.

- State Support for Research in Traditional North Carolina Industries

  State support should continue to be provided and, if warranted, increased for research and R&D activities designed to improve productivity and quality in traditional North Carolina industries, such as textiles and apparel, agriculture and forestry, and furniture.

  State support should also be provided for research and R&D activities to improve waste management, decrease consumption of energy and natural resources, and improve occupational safety and health conditions in North Carolina industries.

Training and Retraining. New technologies, combined with innovative management techniques and increased participation by labor in planning and decisionmaking, hold great promise in efforts to regain and retain the competitive edge of North Carolina industries. The rate of job losses from manufacturing can possibly be slowed and even halted through far-sighted planning and innovative investments.

Technological innovation has the potential of keeping the North Carolina textile and other traditional industries viable, thereby retaining important manufacturing jobs. But new technologies also eliminate jobs. It has been estimated that low-technology robots can eliminate 15 percent of the jobs in heavy industry, and high-technology robots can eliminate up to 40 percent of the jobs. For every robot that is installed, a new job is created at the expense of five original jobs.

Technological innovation has eliminated jobs not only for unskilled production workers, but also for skilled and semi-skilled workers and even managers. The Congressional Budget Office has estimated that one to three million factory jobs could be lost to robots by 1985, and seven million by 1990. Robots and computers could eliminate an additional three million jobs of skilled workers over the next 20 years. Although the United States has only half the number of robots that are used in Japan (6,200 compared to 12,000 robots), the number of robots is increasing at a rate of about 2,000 per year, particularly in steel and automotive factories in the Midwest.

Robots are still relatively new to the textile industry; only about 800 are in use in the Southeast, mostly in the larger textile companies. The number of robots in North Carolina has been estimated at fewer than 100 machines at about two dozen plants. Automation and the use of robots enabled Burlington Industries to reduce its workforce by 25 percent at the new Erwin plant. To the extent that textile firms and companies in other industries are able to afford the price of robots -- ranging from $50,00 to $150,000 for some of the larger robots -- there is the potential for substantial automation of the North Carolina industrial base and, consequently, the loss of increasing numbers of manufacturing jobs. The Task Force therefore recommends:

- Training and Retraining

  A comprehensive North Carolina strategy for economic revitalization should focus, in particular, on the creation of job opportunities for laid-off workers and for new workers entering the labor force.

  But a comprehensive strategy for economic growth and job creation should also focus on training and retraining for displaced workers that need new skills for new jobs in the firms in which they have been employed, or for new occupations in other industries.

  People entering the labor force, particularly women and minorities, need training in the skills required by emerging new industries and by revitalized traditional industries.

  Training and retraining opportunities should be provided on-the-job, in institutions of higher education, and other innovative sites, and these opportunities should be both affordable and readily accessible.

  There is a need for a comprehensive study of training needs and trends in North Carolina, of the effectiveness and efficiency of existing programs, and of the appropriate location, mechanisms and amounts of funding that are required to address the training and retraining challenge.

It is clear that training and retraining must be a top priority, both in North Carolina and the nation as a whole. But training and retraining programs, however important, are not a panacea or a cure-all for all our economic woes. Training and retraining programs will have an impact on unemployment and underemployment rolls only to the extent that there are, in fact, more jobs and higher-skill jobs to be filled with qualified workers.

It cannot be emphasized enough that the overridding challenge is job creation -- more and better jobs for everyone. This emphasis on job creation is not intended to detract from the critical need for training and retraining programs; but it does suggest an acknowledgement of the growing divergence between high-technology expectations and real-world evidence. Data for the nation indicate that, by 1995, the greatest number of jobs will be created not in high-technology fields but in lower-skill service sector positions: building custodians (779,000 more jobs), cashiers (744,000), secretaries (719,000), office clerks (696,000), salesclerks (685,000), registered nurses (642,000), waiters and waitresses (562,000), and elementary school teachers (511,000).

At the same time that jobs are being created in the service sector, jobs are being lost largely in manufacturing: railroad conductors (32 percent decline in job opportunities by 1995), shoemaking and machine operators (30 percent decline), aircraft assemblers (21 percent decline) telephone operators (20 percent decline), taxi drivers (19 percent decline), postal clerks (18 percent decline), household workers (17 percent decline), and farm laborers (16 percent decline). Many of the workers affected by job losses in these areas are likely to have no other choice but employment in the above-mentioned service areas, unless innovative new strategies and initiatives are developed in both the public and private sectors to create more jobs and more rewarding jobs and to train workers for those positions.

Innovation in Agriculture and Forestry

Agriculture continues to be a major economic force, both in direct agricultural sales and in the related equipment, supply, processing, and marketing businesses it generates. The structure of agriculture in the United States provides a dramatic illustration of the relationship between technical and organizational innovation. Technical breakthroughs in agricultural equipment have forced the reorganization and consolidation of agriculture, so that farm families now comprise four percent of the North Carolina population, compared to 90 percent of the population when this nation was founded. Fewer people are engaged in farming, farms are larger, and production is unprecedented. The estimate for agricultural employment in July 1983 is 166,000 (see Table 4D). This estimate includes temporary and part-time hired farm workers as well as full-time, self-employed farmers and their families. Some of these farm workers also hold full-time or part-time jobs in other sectors of the economy.

TABLE 4D

EMPLOYMENT IN AGRICULTURE AND FORESTRY INDUSTRY IN NORTH CAROLINA, 1983

Agricultural Labor Force	July 10-16, 1983	July, 1982
A. Self-employed workers (full-time farmers)	36,000	49,000
B. Unpaid workers (farm family members)	21,000	44,000
C. Hired workers		
More than 150 days/year	25,000	28,000
Less than 150 days/year	84,000	123,000
	166,000	244,000

Source: N.C. Department of Agriculture

About 75 percent of all North Carolina farm families are classified as small farmers because their farm-gate sales are $20,000 or less per farming unit. This group constitutes more than 68,000 families according to the 1980 census. At present, small farms account for only 17 percent of total farm income even though their aggregate acreage is about 44 percent of the state's crop lands. About 70 percent of small farmers grow tobacco or grain crops; about 15 percent produce cattle or other livestock. Small farmers generally own and operate their own farms. About 30 percent are black or of Indian ancestry; many are poor or elderly, or both. More than 25 percent of North Carolina small farmers are over age 65. Many supplement their income by part-time or seasonal employment off their farms. Most low-income small farmers are located west of Raleigh, with the highest proportion in the Mountain region of the state.

Two-thirds of North Carolina's total land area is forest. Sixty-nine percent of this huge land area is in tracts of 5 to 5,000 acres which are owned by 450,000 families, many of whom are also small farmers. Everyone of these owners has his or her own mix of goals for management of this land for timber, wildlife, recreation, water, and aesthetic or other values. Appropriate technology with which to meet these goals is available, but it is not adequate to achieve anywhere near the full productive potential of the land. Education of small woodlot owners is achieved by four principal groups: university extension specialists, county extension agents and service foresters, industrial land-owner assistance foresters, and private forestry consultants. All four groups need to be strengthened both in terms of available manpower and in terms of knowledge and breadth of experience with alternative management systems for various types of forest lands and owner management goals. The technical needs of small farm and forest owners should be met by strengthening existing research and advisory services.

Agribusiness -- the production of farm machinery, processing and marketing of farm products, and other functions related to agriculture -- has become an important and growing sector of our economy (see Table 4E).

Over the past century, the quality of life in North Carolina has been determined in large part by substantial investments in science and technology that made the state's agricultural, forestry and fishery industries both productive and efficient. These investments have paid dividends to the people of North Carolina -- jobs in rural communities, wholesome food of high quality at modest prices, useful fibers for textile and paper products, timber for homes and furniture, abundant wildlife, and a wide variety of recreational and aesthetic opportunities.

TABLE 4E

AGRICULTURE, FORESTRY AND FISHERY SERVICE INDUSTRIES IN NORTH CAROLINA

SIC Code and Industry	Number of Firms		Average Annual Employment	
	Number	Percent	Number	Percent
01 Agricultural Production-Crops	426	.33	6,160	.26
02 Agricultural Production-Livestock	149	.11	4,306	.18
07 Agricultural Service	1,321	1.04	6,853	.29
08 Forestry	71	.05	555	.02
09 Fishing, Hunting & Trapping	18	.01	40	.001
Total 01-09	1,985	1.56	17,914	.77
RELATED INDUSTRIES				
20 Food and Kindred Products	664	.52	44,043	1.90
241 Logging Camps and Logging Contractors	774	.59	3,564	.15
287 Agricultural Chemicals	52	.04	2,660	.11
352 Farm and Garden Machinery and Equipment	49	.04	2,032	.09
514 Groceries and Related Prod.	1,147	.90	17,615	.76
515 Farm Product Raw Materials	511	.40	5,320	.23
54 Food Stores	4,544	3.58	59,644	2.58
58 Eating and Drinking Places	7,457	5.87	106,307	4.60
Total	15,168	11.94	241,185	10.43
Total Services and Related Industries	17,153	13.51	259,099	11.20
All Industry Total	126,991	100.00	2,312,552	100.00

Source: N.C. Employment Security Commission (unpublished data), June 9, 1983.

If North Carolina is to retain its strong and competitive position in the United States and international economy, there is a clear need for the continued support of scientific and technical enterprises from which technological advances in agriculture, forestry and fisheries have come. Many of these advances will come from research in the sciences and technologies that undergird the agriculture, forestry and fishery industries. Other advances will result from the removal of obstacles impeding the progress of science and technology in North Carolina. Still other advances will come from improvements in science education and through increased technology transfer from the state's research institutions to those who can benefit from scientific and technological breakthroughs.

Our agriculture, forestry and fishery industries generate products that are consumed by all members of society. As basic needs, food and shelter have no parallels in society. Science and technology have enabled major advancements in food and fiber production, processing, storage and distribution. These advancements have released labor from agriculture to manufacturing, thereby contributing to productivity increases in nonagricultural sectors of the economy. They have also lowered the cost of food; American consumers spend a lower percentage of their income on food than consumers in any other nation.

Technological advance has enabled the United States to become a major exporter of food and fiber. Agriculture is one of the few bright spots in the nation's overall balance of trade picture; our export/import ratio in agricultural products is two to one. North Carolina is the leading agricultural export state in the Southeast. The South is the world's major source of softwood fiber. Twenty percent of the labor force in North Carolina is engaged in the production and processing of timber products.

But, as in other sectors of the economy, the rate of increase in productivity has been slowing down in agricultural production over the past several decades, both in absolute terms and relative to other nations. Renewed efforts must, therefore, be made to ensure that consumers retain access to low-cost, high-quality food, and to enable the United States to maintain its position as a major world exporter of food and fiber. Further technological advances hold the promise of enabling additional gains in productivity and the maintenance of our competitive edge, both as a state and as a nation. The federal government has been a major source of financial support for basic research. The rates of return on public expenditures in agricultural research have been consistently high -- close to fifty percent. The expectation is that comparable returns can be anticipated for current and future investments in this area of economic activity.

While there is general support for the concept of federal support for research, some questions surround state government investments in basic research. Research supported with public monies differs significantly from private sector research and development efforts in the sense that the former is considered part of the public domain. Questions arise about the distribution of benefits from publicly-funded research. For example, what are the benefits to North Carolina from investments in agricultural research, where knowledge gained from that research is quickly disseminated to parties that did not necessarily participate in the initial investment? Can North Carolina afford to finance this type of research, or should we aim to become secondary beneficiaries of research done by the federal government or other states?

The answer to these questions hinges on the concept of "spillovers" from one location to another. It has already been documented that states have benefitted greatly from the research they have supported; state-supported research has accounted for 33 to 67 percent of the change in productivity experienced by these states, depending upon the type of research and the regional location of the state.

Another finding is that the more intensive the agricultural industry is in a state, the greater the benefits per dollar of investment. North Carolina's agricultural industry is already considered very advanced and intensive and could, therefore, stand to achieve considerable gains from additional investments and advances in science and technology. For example, in 1976 the estimated dollar return from an additional dollar of public investment in poultry research was $12.90 in North Carolina. This relatively high rate of return has been attributed to the concentration of the poultry industry in the state, which facilitated the dissemination and application of research results.

In sum, the evidence indicates that North Carolina would experience considerable gains from additional investments in science and technology as they relate to agriculture, because the returns on such investments are high and most of the benefits from this research could be retained in the state. Specific recommendations to strengthen the state's agricultural and forestry enterprises were developed by a special Committee on Agriculture and Forestry of the Governor's Task Force on Science and Technology. The Committee is issuing a separate report providing details on issues and options related to agriculture and forestry.

Conclusion

Over the next several decades, North Carolina must take advantage of technological innovation to increase the efficiency and productivity of its present economic base. Faced with stagnant economic conditions and increasing competition, North Carolina's major industries must employ "cutting edge" technologies to produce high-quality goods and services at the lowest possible cost. As North Carolina moves with national trends toward a more service-based economy, the state must also strive to increase productivity in service industries through the application of new technologies.

To the extent that the modernization of plant and equipment enables a firm or entire industry to remain viable, technological innovation will benefit workers. Jobs will be retained for workers trained to work with the new equipment, instead of everyone losing their job because the plant was closed.

But the modernization and mechanization of traditional North Carolina industries will also lead to increased lay-offs and decreased job opportunities in this sector. Advanced technologies must be applied with great sensitivity to conditions within each industry, particularly labor-management relations. Any plan for significant changes in the production process is likely to enjoy greater success if it is developed with full participation of all affected parties, and includes provisions for training or retraining the labor force.

Meeting the challenges of the future in the state's traditional industries will require a cadre of managers with long-term perspectives, a strong research base, a capacity to transfer technology from the laboratory to the work place, an enlightened labor force, and perhaps most important, a sufficient pool of investment capital.

Chapter Five

CREATION AND DEVELOPMENT OF NEW SMALL BUSINESSES

In the long-run, the key to continued economic prosperity and the creation of new and better jobs for North Carolina workers lies with strategies designed to help individual inventors and entrepreneurs start new businesses and to help existing small firms in the state expand and thrive.

Small businesses are already the backbone of the North Carolina economy. Of the 126,991 firms in all sectors of the state's economy, 97 percent are small firms employing less than 100 persons and 86 percent are very small firms with fewer than 20 employees. These percentages are comparable to national averages, but the rate of growth of small businesses between 1970 and 1980 was somewhat higher in North Carolina (32 percent) than in the nation as a whole (29 percent).

Small firms with fewer than 100 employees constitute about 80 percent of all manufacturing firms in North Carolina, while very small businesses employing less than 20 persons are about evenly split between manufacturing and non-manufacturing activities. These percentages are slightly lower than the national figures (87 and 61 percent, respectively) but, between 1970 and 1980, these classes of manufacturing increased at a somewhat faster rate in North Carolina (12 percent) than in the nation (7 percent).

Differences between North Carolina and the United States persist in the "high technology" categories as well. Small businesses constitute 72 percent of all high-technology manufacturing firms in North Carolina (83 percent in the United States), and very small firms comprise 52 percent of the firms in these categories (57 percent in the nation). But rates of growth among small and very small high-technology manufacturing firms are much higher in North Carolina than in the nation. For example, the number of very small firms engaged in high-technology manufacturing increased 96 percent since 1970, while the comparable figure for the nation as a whole is only 25 percent. Small businesses in North Carolina are particularly important in such categories of activity as data processing services (94 percent of all such firms), research and development laboratories (91 percent), medical and dental laboratories (99 percent), and metalworking machinery (92 percent).

The Special Role of Small Business

Small businesses are an important foundation of the North Carolina economy, and data indicate they will continue being major sources of employment in the future. Small businesses have the added appeal of generally being "home grown" -- most small ventures in the state were started by North Carolinians. Having been started in North Carolina, these small firms are likely to stay in the state and in the communities where they were started. Entrepreneurs often have personal knowledge or extensive secondhand information on the communities in which they start their companies, and communities generally take an active interest in the start-up and success of local businesses.

The symbiotic relationship that often characterizes relations between small businesses and communities in North Carolina is often more difficult to foster with plants and division headquarters of major national or international companies. Local communities can be actively involved in industrial recruiting and they take an active role in creating an environment conducive to the growth and expansion of firms. But localities can do little in the event of corporate decisions to scale down or close a plant, particularly when corporate headquarters are outside North Carolina.

Plant closings are a special concern with large national and international corporations because parent companies do not necessarily develop a personal stake in the communities in which they locate. But they are also a concern because of the growing trend among large corporations to locate low-skill production activities overseas in countries where labor costs are low. This phenomenon has already been well-documented in such traditional industries as textiles and steel manufacture. But there is also evidence of a similar trend among high-technology firms, as indicated by the Atari decision to locate low-skill production activities in less-industrialized countries where wages are very low.

It has been suggested that the United States may be headed toward an economy where virtually all low-skill manufacturing will be done overseas. The United States could become a nation of skilled workers, professionals, entrepreneurs and thinkers, educated and trained in the new technologies.

But the United States could also become a nation of widening gaps between the employed and unemployable, the educated and the illiterate, the haves and the have-nots. Unless every citizen is educated and trained for a new-technology era and new jobs are created in technology-based firms, an increasingly intractable unemployment and underemployment problem could be in the making. Unless economic development policies focus, in particular, on employment opportunities for unskilled and semi-skilled workers, we could be headed toward the creation of a permanent underclass of the unemployable and the underpaid working largely in the service sector.

Industrial development policy must, therefore, emphasize the retention of manufacturing jobs, particularly in lower-skilled areas. Low-skilled manufacturing jobs generally pay more than low-skill service sector jobs, and the opportunities for upward mobility are greater in manufacturing. More specifically, economic development strategies should focus on the development of small businesses, because small firms engaged in manufacturing are less likely than large firms to locate manufacturing activities overseas, for the simple reason that most small firms cannot afford to operate more than one facility. Small businesses may well become the leading sources of lower-skilled manufacturing jobs in the United States in the future.

The final advantage of small businesses is that they appear to be somewhat more resilient or insulated from fluctuations in the national and international economy than are large corporations. A number of explanations for this phenomenon have been offered: greater ability on the part of smaller firms to anticipate and adapt to changing market conditions; greater emphasis in smaller firms on highly specialized products or services instead of mass production of relatively non-complex products; reinvestment into the existing small business rather than diversification into unrelated areas; and less complex management structure and financing arrangements. Large firms and corporations with these characteristics have also enjoyed greater success in weathering the recession than their less innovative counterparts. The key, for both large and small firms, is technical, managerial and financial innovation.

Financial Support

In most states, inventors and entrepreneurs, particularly in new-technology areas, find it difficult to gain access to funds for starting a new business. Persons seeking to start a business must use their own personal resources or turn to family and friends for financial support. Loans from banks, when available, are often on terms that are not acceptable to entrepreneurs who are just getting started. In the business community and in our universities and colleges, there are plenty of inventors and innovators with good ideas for new products and services. An essential key to the translation of these ideas into marketable products and services -- and into viable new businesses -- is financial support.

For businesses to get started, financial support is needed at three stages: (1) to develop a prototype of a product or service, (2) to begin marketing a product or service, and (3) to grow and expand as a viable business. The nomenclature for financing at these three stages of business development is (1) "start-up" or "seed" capital, (2) "first stage" financing, and (3) "second stage" or "venture capital" financing. These three stages of business development coincide with the three phases of funding outlined in the federal Small Business Innovation Development Act of 1982. This legislation requires federal agencies with R&D budgets in excess of $100 million to set aside a growing percentage of those funds for the establishment of a Small Business Innovation Research (SBIR) program. Only small businesses may compete for SBIR awards. The total value of set-asides for small business research will be about $45 million in fiscal year 1983, increasing gradually to $500 million by 1988. The SBIR funding procedure has three phases:

Phase I:	Agencies will award up to $50,000 for research projects to evaluate the technical and economic feasibility of an idea.
Phase II:	Those projects which have the most potential will be funded one or two years for up to $500,000. This support is to further develop the proposed ideas in accordance with agency needs. Only Phase I award recipients are eligible for Phase II awards.
Phase III:	This entails private sector investment (or agency follow-on) production contracts to exploit possible commercial application of the innovations derived from federal research and development.

The purposes of this legislation and funding procedure are: (a) to stimulate technological innovation, (b) to encourage the participation of small science and high-technology firms in government research, and (c) to provide incentives for the conversion of research results into commercial applications. The SBIR program provides a useful model for funding at three distinct levels.

North Carolina Innovation Research Fund. During the 1983 Session of the General Assembly, the New Technology Jobs Act (H.B. 1122) was enacted, creating a North Carolina Technological Development Authority (NCTDA). The Authority was assigned responsibility for the operation of a "North Carolina Innovation Research Fund," providing equity financing for the research stage of business development. This legislation is significant in that it sets a precedent for seed capital financing in North Carolina.

The Fund was modeled somewhat after the Connecticut Product Development Corporation (CPDC), a quasi-public institution created by the Connecticut Legislature in 1972. CPDC makes joint venture investments in new products with the expectation of recovering this investment through royalties on product sales. CPDC protects its investments by making development agreements with contracting entrepreneurs which assign all rights to abandoned products to CPDC. CPDC may then, in turn, license or sell the rights to the product to another manufacturer.

Between 1975 and mid-1982, CPDC committed $5.3 million to the development process for 46 new products. Products range from sophisticated computer-controlled telecommunications equipment, solar collector panels and electronic components to frozen seafood fritters, bathroom accessories, and hook and loop fasteners. Seven of these products have been abandoned for various reasons, for a net cost to CPDC of about three percent of the funds committed.

Total taxpayer investment in CPDC operations through fiscal year 1981 was $3.7 million, of which $804,000 has already been returned to CPDC in the form of royalties. The royalty income expected for fiscal year 1982 is between $750,000 and $1,000,000 on product sales of $15 to $20 million. Royalty income as a percent of total taxpayer investment in CPDC was 15.3 percent in fiscal year 1981. One of the objectives of CPDC is to become self-sustaining and to repay the investment made by Connecticut taxpayers. Since fiscal year 1980, royalty income has exceeded CPDC operating expenses. During fiscal year 1982, CPDC expected to fund new development projects out of its royalty income. Having achieved the goal of becoming self-supporting, CPDC expects to become independent of state support through the general revenue bonding process and ultimately repay initial taxpayer capitalization.

While CPDC has many of the characteristics of a private venture capital company, the Corporation's legislative mandate is to maintain and create jobs in Connecticut. As such, CPDC is an "investor of last resort" in products that promise good returns but are considered "high risk" by conventional investment criteria. CPDC estimates that, as a consequence of Corporation investments, about 100 full-time jobs in product development and about 200 full-time jobs in manufacturing, marketing and distribution were created in fiscal year 1981. The expectation for fiscal year 1982 is about 500 jobs.

Similar to CPDC, the newly-created N.C. Innovation Research Fund has been designed to serve as financer of last resort. The Fund will take an equity position in contracting businesses through the purchase of stock, the receipt of royalties, or other equity instruments. All equity returns are to be funneled back into the Fund for further reinvestment.

Awards per research project may not exceed $50,000 per calendar year, and they will be limited to businesses physically located in North Carolina. To protect its investments, the Authority may make "development agreements" with contracting businesses, to ensure proper use of Fund awards and the receipt of royalties, where appropriate. Development agreements will assign all rights to abandoned projects to the Authority.

The Fund will be administered by a not-for-profit institution -- the N.C. Technological Development Authority -- but the expectation is that its operating expenses will be covered within a certain number of years and that complete self-sufficiency will be achieved in the long-run. Capitalization will come from a combination of public (state appropriations, leveraging of federal monies, and local government contributions), private and foundation monies. The state appropriation for fiscal year 1983-84 is $225,000 and for fiscal year 1984-85 it is $250,000.

The expectation that the Fund will become self-sufficient in the long-run requires investment decisions that are based on sound business judgement. Board members and staff of the Authority will need to consider the potential of research projects to culminate in the development of new or improved products and services that can be marketed successfully and, thereby, generate equity returns for the Fund. However, as an agent of state government with a mandate "to increase the rate at which new jobs are created in all regions of the state, " the Authority must also place equal emphasis on the potential of projects to stimulate job creation in communities where new job opportunities are most needed. In other words, for the Fund to become a successful legislative initiative, Authority staff and Board members will need to exercise sound business judgement and meet the public purpose of the enabling legislation.

The Authority is empowered by law to "apply for and accept grants of money from the State of North Carolina, or any political subdivision thereof, from the United States, or from any person, corporation, foundation, trust, or business, or from any foreign government." Therefore, in addition to its major programmatic responsibilities, the Authority is responsible for raising the funds needed to operate a viable equity fund. The effectiveness of the Authority should be evaluated on the basis of its success in selecting worthwhile projects for funding through the NCIRF and the Incubator Facilities Program (discussed in the section on "Management and Technical Support"). But the Authority should also be judged on the basis of its ability to augment its initial capitalization with non-State sources of support. It has been suggested that capitalization of at least $3 million is required for a viable equity fund. Until the time when royalty income and non-State funding enable the Authority to become self-sufficient, however, it is critical that the Fund continue to be capitalized with state tax revenues. State appropriations provide evidence of government support for the purposes and accomplishments of the Fund and can, thereby, serve as a catalyst for non-State contributions to the Fund.

North Carolina Innovation Loan Program. In addition to its royalty investment program, the Connecticut Product Development Corporation recently established a revolving loan fund. Called the Connecticut Innovation Development Loan Fund (CID), this program provides low interest working capital loans to companies with innovative new products. These loans can be used as capital for start-up, inventory buildup and marketing for companies in designated long-term, economically disadvantaged areas of the state. Matching grants from the federal government and CPDC were used to create this Fund. The Task Force therefore recommends:

o North Carolina Innovation Loan Program

A North Carolina Innovation Loan Program should be created, under the auspices of the North Carolina Technological Development Authority.

The Loan Program would be a complement to the North Carolina Innovation Research Fund, thereby providing small business concerns and entrepreneurs with an option between debt and equity financing. To implement this recommendation, the New Technology Jobs Act would need to be amended to permit debt financing for the research stage of new or improved product or service development. Two separate funds would be required for the debt and equity financing programs. The Innovation Research Fund provides equity financing -- as stipulated in the Act -- and returns from equity arrangements are channeled back into the Research Fund for further reinvestment. Similarly, a Revolving Loan Fund would enable the reinvestment of returns from loan arrangements.

Both the Research Fund and the Revolving Loan Fund should become self-sufficient within five to seven years, and ultimately enable the repayment of the initial capitalization from state tax revenues. The revolving Loan Fund would be capitalized from a variety of sources in the same manner that the Research Fund may be capitalized. The Loan Program would have the same mission, selection criteria and administrative arrangements as the Innovation Research Fund: the creation of new small businesses in regions of the state where job creation and economic revitalization are most needed.

Venture Capital. The North Carolina Innovation Research Fund and the proposed North Carolina Innovation Loan Program are designed to provide seed capital. This type of financing is critical to the start-up of new small businesses and to the development of new or improved products and services in existing firms. As small businesses grow, larger sums of money are required for expansion and innovation projects. At times, financing for these projects is available from conventional sources. However, firms based in the new technologies are generally considered too "high risk" by conventional investment standards. These firms need access to new and innovative financing mechanisms, such as venture capital. Venture capital is a form of high-risk financing for growth-oriented businesses, promising investors high returns within five to ten years of the initial investment. Venture capitalists generally assume equity ownership in firms, instead of providing loans.

Venture capital funds have more than doubled in the United States since 1977, increasing from $2.8 billion to $5.8 billion (1982). The major sources of venture capital are pension funds (32 percent), private individuals and families (16 percent), insurance companies (16 percent), foreign investors (15 percent), private corporations (13 percent), and endowments and foundations (8 percent). While venture capital activity has increased substantially since the mid-1970s, this activity has not been evenly distributed throughout the United States. More than three-fourths of all private venture capital is located in only five states: New York (27 percent), California (22 percent), Massachusetts (13 percent), Illinois (12 percent), and Connecticut (4 percent). And disbursement of these funds is as uneven as its initial distribution, with states such as California, Massachusetts, New York and Texas receiving a disproportionate share.

The problem is that venture capitalists based in the Northeast are generally reluctant to invest in North Carolina firms because distances could jeopardize the ongoing and active involvement of venture capitalists in contracting businesses that is considered essential to successful investment. Clearly, there is a need for at least one major venture capital firm in North Carolina, and in the Southeast in general, to stimulate the growth of innovative, technology-based firms in this region.

The preference is for venture capital firms in North Carolina to be organized totally in the private sector, although a number of states have established public or quasi-public venture capital funds. Private venture capital firms would complement and build upon the State's activities under the New Technology Jobs Act. It has been suggested that a minimum level of capitalization of $30 million would be required for a firm to receive recognition as a major venture capital fund, with a level of $60 million being a desirable target. Although it may be possible for a single institution to develop such an initiative, it may be desirable to consider what a group of North Carolina institutions could achieve jointly, particularly in view of the target capitalization.

Nurturing the growth of small, technology-based firms is essential to North Carolina not only because of its direct impact on the economy, but also because such firms often serve as sources of productivity-enhancing innovation for existing industries and for major industries that might be induced to locate in the state. A number of individuals and institutions in North Carolina have already expressed an interest in the creation of venture capital funds in the state. It is critical that any initial effort to create a venture capital fund be successful in order to ensure that the opportunity to create a healthy venture capital environment in the state is not wasted. The Task Force therefore recommends:

o Private Venture Capital

  Business and financial leaders and government officials at the highest levels and Members of the General Assembly should take an active interest in the creation of one or more private venture capital funds in the state.

Clearinghouse for Financing Information and Referral. The primary recommendation to emerge from a "Small Business Seminar" sponsored by the State Goals and Policies Board on July 27, 1983, was the need for a statewide clearinghouse for information on support for small businesses. The consensus was that a variety of private and public sources of support for technological innovation and the creation of new small businesses already exist. Yet there is no one place where an interested entrepreneur or small businessperson can receive up-to-date information on resources in all parts of the state.

Business concerns and entrepreneurs in North Carolina need to be familiar with the range of private as well as federal, state and local government sources of financial support that are already available. As a first step in the creation of an entrepreneurial climate in this state, one or more institutions are needed for the timely dissemination of information on alternative funding sources. These institutions would serve as brokers between businessmen or entrepreneurs seeking funding and institutions or individuals interested in financing new enterprises. The Task Force therefore recommends:

- N.C. Department of Commerce Role

  The N.C. Department of Commerce should assume an even more active role in identifying sources of financial support for entrepreneurs and small businesses that are available through various federal and state programs, and in developing measures to foster access to these sources of funding. Implementation of this recommendation would require a new perspective and a reorganization of activities in the Commerce Department, and it could necessitate the appropriation of additional monies for staff.

The U.S. Small Business Administration, National Science Foundation, Farmers Home Administration, and U.S. Department of Commerce are among the federal agencies that currently or in the past have provided financial support for entrepreneurs and small businesses, directly or through state programs. Steps should be taken to ensure that North Carolina takes full advantage of all federal programs designed to promote economic development and the start-up of new businesses.

As already indicated, small technology-based or innovative businesses have special financing concerns. They need information on sources of financial support for high-risk ventures, and they often need specialized advice on financial matters. The Task Force therefore recommends:

- Role of N.C. Technological Development Authority

  The North Carolina Technological Development Authority should serve as a clearinghouse for information on sources of financial support for small technology-based or innovative firms.

  When a project is turned down for funding from the Authority, an explanation for the rejection should be provided, including advice on alternative sources of funding.

  The mandate of the North Carolina Technological Development Authority should be broadened to include responsibility for serving as a source of advice on financial matters for small technology-based or innovative firms.

  Additional funding for the Authority should be provided for this activity. Both one-on-one specialized advice and more general group advice -- through seminars or workshops -- should be offered through the Authority. Development agreement with small firms receiving Innovation Research Fund support should include Authority consultation on financial and other matters of sound business management.

Technical and Management Support

In addition to financial support, entrepreneurs and small businesspersons often need technical and management advice to assist them in transforming their ideas into marketable products and services. A number of states have taken steps to encourage and facilitate small business access to management and entrepreneurial advice. Most of these initiatives are university-affiliated, drawing upon the expertise and resources available at schools or colleges of business and economics. Some of the initiatives are SBA-sponsored Small Business Development Centers. Examples of services include: marketing analysis, patenting and legal advice, development of a business plan, proposal writing assistance, financial analysis, and business education seminars.

Some states have programs that are described as providing technical support for businesses. Again, most of the programs are university-affiliated, usually involving schools of engineering and departments in the natural sciences. Some of the programs are focused specifically on promoting new-technology innovation.

Still other states have developed initiatives that provide both management and technical support. Institutions of higher education can have an important, often primary, role in providing this type of advice to businesspersons and entrepreneurs. Advice may be needed for only a few hours or on a more long-term basis, and institutions of higher education will vary in the extent to which they are willing and able to provide that advice. An impressive number of institutions of higher education have taken steps to encourage and facilitate small business access to their resources. These steps can range from tacit approval to official policy pronouncements by institution administrators, and from informal *ad hoc* agreements between individual faculty members and small businesses, to the creation of formal structures established primarily for the purpose of providing services to the business community.

In North Carolina, several steps have been taken to foster the consulting role of our institutions of higher education. For example, N.C. State University operates an Agriculture Extension Service through its School of Agriculture and Forestry, and an Industrial Extension Service through its School of Engineering. Through its Urban Institute, UNC-Charlotte has established a very productive working relationship with the Metrolina business community, the results of which are likely to provide a model for university-industry cooperation.

Incubator Facilities Program. Many states have expressed an interest in the creation of incubator facilities, but only a few states have actually established such centers. Examples of such centers are: the Advanced

Technology Development Center (ATDC) on the campus of Georgia Institute of Technology; the Utah Innovation Center of the University of Utah; the Incubator Program at Rensselaer Polytechnic Institute in Troy, New York; and the University City Science Center in Philadelphia.

The precise approach to an incubator facility can vary along a number of dimensions -- services, funding, size, location and cost. At a minimum, an incubator facility simply provides open space for small businesses and entrepreneurs. Inventors may not be far enough along the way to take the risk of buying or constructing a building of their own, and empty space at commercial rates may be too expensive for businesses in the start-up stages. Open space at affordable rates can make the difference between starting a new enterprise or not.

Depending upon the degree of interest and availability of funding, incubator facilities generally range in size from 10,000 to 100,000 square feet. A facility can start small and expand as conditions and support change. The physical structure can be either an entirely new building, constructed for that purpose, or a renovated building. Incubator facilities have been run equally successfully in both new and renovated buildings.

In addition to the availability of space, incubator facilities can also provide convenient access to secretarial and other types of support services. Support services can be pooled, as well as access to conference rooms, duplicating and mailing facilities, and computer time.

Technical and management advice are often needed on an ad hoc or ongoing basis. For example, an inventor may have the technical competence to devise a new or better product, but this person may not be skilled in marketing and business management. Convenient access to management and marketing advice may be crucial to the success of a new business venture. Similarly, an entrepreneur may have a very good idea for a new product but may come across a difficult technical problem. In this situation, ready access to technical advice, for as little as five minutes to as much as several months, could help the inventor through critical stages of product development. Incubator facility affiliation with institutions of higher education that have schools of engineering and business administration and departments in the natural sciences would enable ready access to technical and management advice.

The Advanced Technology Development Center (ATDC), for example, provides access to the faculty at Georgia Tech for technical advice. The Center also provides access to Georgia Tech library and computer facilities and sophisticated training equipment, as well as a number of support services to improve the basic management skills of businesses. Control Data WORLDTECH business and technology centers are an example of privately-run, for-profit incubator facilities providing a wide range of services. Arrangements can be made with local lawyers and accountants, that are themselves just getting started, to set up their practices in incubator facilities, in return for rent-free space and the potential of clients.

In addition to affiliation with an institution of higher education, it is essential for an incubator facility to have active support from the local business, labor and financial community. In Craven County, for example, the local "Committee of 100" raised $150,000 to build a structure providing 4,800 square feet of empty space for rent by small businesses. Having established the basics of an incubator facility, it may be possible for the Craven County Committee to expand their concept of a small business center to include access to technical and management advice through nearby community colleges and technical institutes.

One of the most important factors in the success of an incubator center is the ability of small businesses and entrepreneurs to afford the rent. Annual rent of up to $5 or $7 per square foot is generally considered within the financial means of most small businesses; higher basic rent and steep prices for technical and management services will effectively eliminate participation by small businesses that are just getting started.

The New Technology Jobs Act provides funding for an "Incubator Facilities Program," administered by the North Carolina Technological Development Authority. Local communities may apply for one-time grants from the Authority for the the establishment of an incubator facility. A grant may not exceed $200,000 and the grant must be at least equally matched with non-State monies.

Only non-profit corporations affiliated with local institutions of higher education are eligible to receive an incubator facility grant. Both the importance and opportunity for affilifation with a local university, college, community college or technical institute can be seen in Figure 5A, "North Carolina Post-Secondary Institutions, 1982-83." Corporations receiving grants are responsible for managing and maintaining the facilities, and for providing access to technical, management and entrepreneurial expertise to facility residents and to small business concerns throughout the area. A small business may reside in an incubator facility for no more than two years.

The Authority is responsible for reviewing proposals for the establishment of incubator facilities and for selecting communities that will receive awards. The General Assembly authorized $200,000 for this program in both fiscal year 1983-84 and fiscal year 1984-85. The funding for one year could be expended on only one grant or divided among a number of smaller grants.

In selecting sites for incubator facilities, the Authority is required to use the following criteria: (1) the local unemployment rate, (2) the need for industrial and economic diversification and development in a community, and (3) the interest of the community in establishment of an incubator facility, as manifested by financial commitments from public and private sources and cooperative agreements with local government, business, labor and educational institutions. The Task Force recommends:

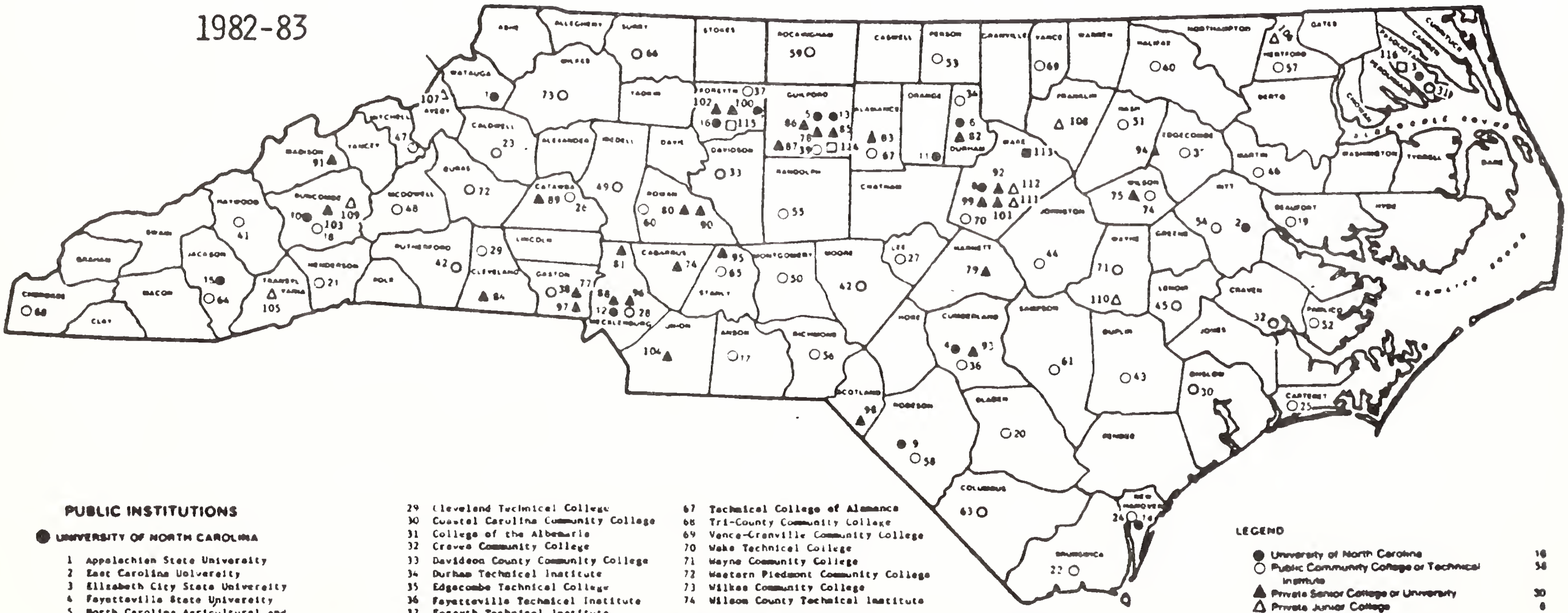
o Incubator Facility Program

Funding should be provided for the creation of incubator facilities in all regions of the state where the need for job creation and economic revitalization is greatest.

The Authority should also encourage the establishment of incubator facilities with private and non-State funding.

NORTH CAROLINA
Post-Secondary Institutions
1982-83

Figure 5A



LEGEND

● University of North Carolina	16
○ Public Community College or Technical Institute	58
▲ Private Senior College or University	30
△ Private Junior College	8
Subtotal	112
■ Theological Seminary	1
□ Bible College	3
Total	116

PUBLIC INSTITUTIONS

● UNIVERSITY OF NORTH CAROLINA

1 Appalachian State University
2 East Carolina University
3 Elizabeth City State University
4 Fayetteville State University
5 North Carolina Agricultural and Technical State University
6 North Carolina Central University
7 North Carolina School of the Arts
8 North Carolina State University at Raleigh
9 Pembroke State University
10 University of North Carolina at Asheville
11 University of North Carolina at Chapel Hill
12 University of North Carolina at Charlotte
13 University of North Carolina at Greensboro
14 University of North Carolina at Wilmington
15 Western Carolina University
16 Winston-Salem State University

○ COMMUNITY COLLEGES AND TECHNICAL INSTITUTES

17 Anson Technical College
18 Asheville-Buncombe Technical College
19 Beaufort County Community College
20 Bladen Technical College
21 Blue Ridge Technical College
22 Brunswick Technical College
23 Caldwell Community College and Technical Institute
24 Cape Fear Technical Institute
25 Carteret Technical College
26 Catawba Valley Technical College
27 Central Carolina Technical College
28 Central Piedmont Community College
29 Cleveland Technical College
30 Coastal Carolina Community College
31 College of the Albemarle
32 Craven Community College
33 Davidson County Community College
34 Durham Technical Institute
35 Edgecombe Technical College
36 Fayetteville Technical Institute
37 Forsyth Technical Institute
38 Gaston College
39 Guilford Technical Institute
40 Halifax Community College
41 Haywood Technical College
42 Isothermal Community College
43 James Sprunt Technical College
44 Johnston Technical College
45 Lenoir Community College
46 Martin Community College
47 Mayland Technical College
48 McDowell Technical College
49 Mitchell Community College
50 Montgomery Technical College
51 Nash Technical Institute
52 Pamlico Technical College
53 Piedmont Technical College
54 Pitt Community College
55 Randolph Technical College
56 Richmond Technical College
57 Roanoke-Chowan Technical College
58 Robeson Technical College
59 Rockingham Community College
60 Rowan Technical College
61 Sampson Technical College
62 Sandhills Community College
63 Southeastern Community College
64 Southwestern Technical College
65 Stanly Technical College
66 Surry Community College
67 Technical College of Alamance
68 Tri-County Community College
69 Vance-Granville Community College
70 Wake Technical College
71 Wayne Community College
72 Western Piedmont Community College
73 Wilkes Community College
74 Wilson County Technical Institute

PRIVATE INSTITUTIONS

▲ SENIOR COLLEGES AND UNIVERSITIES

75 Atlantic Christian College
76 Barber-Scotia College
77 Belmont Abbey College
78 Bennett College
79 Campbell University
80 Catawba College
81 Davidson College
82 Duke University
83 Elon College
84 Gardner-Webb College
85 Greensboro College
86 Guilford College
87 High Point College
88 Johnson C. Smith University
89 Lenoir-Rhyne College
90 Livingstone College
91 Mars Hill College
92 Meredith College
93 Methodist College
94 North Carolina Wesleyan College
95 Pfeiffer College
96 Queens College
97 Sacred Heart College
98 St. Andrews Presbyterian College
99 Saint Augustine's College
100 Salem College
101 Shaw University
102 Wake Forest University
103 Warren Wilson College
104 Wingate College

△ JUNIOR COLLEGES

105 Brevard College
106 Chowan College
107 Lees-McRae College
108 Louisburg College
109 Montreat-Anderson College
110 Mount Olive College
111 Peace College
112 St. Mary's College

■ THEOLOGICAL SEMINARY

113 Southeastern Baptist Theological Seminary

□ BIBLE COLLEGES

114 John Wesley College
115 Piedmont Bible College
116 Roanoke Bible College

Small Business Assistance. As already indicated in the preceding section on "Financial Support," participants attending the July 27 "Small Business Seminar" concluded there was a pressing need for a clearinghouse for information on sources of support for small businesses, whether the support be financial, technical or managerial.

Because many studies have shown that innovation in business comes mainly from small companies, much attention has been given to identifying the needs of smaller firms. The needs typically identified are those of (1) adequate sources of capital and (2) management skills. Certainly these are areas in which virtually all small businesses need help, but small technology-based businesses have a special need for quick and reliable information on such concerns as the prototype-manufacturing resources that are available in the state.

A central problem facing small would-be innovators is precisely the fact that they are attempting something innovative: the concept or proposed product must be shown to work properly before undertaking production quantities. Therefore, it is usually necessary to make a small number of initial trial units. The more genuinely innovative the product, the more likely it is that more than one design iteration will be required. This militates in favor of equipping and staffing an in-house prototype-development facility. But few, if any, new small firms can afford this solution if the product involves more than one technical discipline. They are also reluctant to develop in-house research capabilities, because the multidisciplinary staff would be vulnerable to termination at the completion of the development phase unless the company were immediately and unusually successful.

Usually, therefore, the prudent choice is to seek qualified suppliers, each a specialist in a particular discipline, to supply essential parts or services. Locating such suppliers is a surprisingly difficult task: only smaller firms are likely to be willing to accept small orders on a "rush" basis or to undertake experimental processes, and these smaller firms are seldom easy to find. Locating appropriate potential suppliers often occupies at least at much of a company's effort as the development work itself.

Any effort at engendering or sustaining technologically innovative firms must, therefore, include some provision for meeting this special need. Specifically, what is needed is an accurate and comprehensive directory of small-quantity manufacturing shops, speciality fabrication houses, free-lance designers, draftsmen, and consultants throughout the state. To be useful, such a directory would need to be updated frequently, and its existence would need to be well-known to all entrepreneurs. The Secretary of State should supply a copy to each new company when the company name is filed, and add the recipient to the mailing list for continuing revisions of the directory.

Although either the N.C. Department of Commerce or N.C. State University's Industrial Extension Service could maintain such a directory, the crucial requirements of accuracy and timeliness might best be met if the directory could be maintained by a private-sector company. Strong consideration should be given to maintaining the directory in the form of an electronic data base accessible remotely to any firm or individual having a personal computer; this could perhaps be done through the Triangle Universities Computation Center (TUCC).

The problem of frequent updating of perishable information has been addressed by the Canadian "Telidon" System, a large electronic data base in Ottawa which can be accessed by suitably-equipped homes and offices throughout Canada to obtain airline reservations, news, weather, catalog-shopping information, and to engage in electronic banking transactions. The provider of information is responsible for its timeliness and accuracy, the government having initially set up one or more companies to obtain appropriate information and secured the participation of interested suppliers. This suggests that small companies in North Carolina might be willing to underwrite the cost of such a directory by paying a small fee to participate, supplying the necessary information in standard format. The Task Force recommends:

o Small Business Directory

A study should be undertaken to ascertain interest in a directory among small, technologically innovative firms and, if interest warrants, consider establishing mechanisms by which (1) an appropriate private-sector firm can be encouraged to undertake such a project, (2) existing sources of non-confidential information available to State government can be made available to such a project, and (3) the adequacy and continuing performance of such a project can be audited.

The North Carolina Department of Commerce and representatives from the U.N.C. System have already considered the creation of a "Small Business Development Center," funded on a matching basis with the federal Small Business Administration. The Task Force recommends:

o Small Business Development Center

The Task Force supports Commerce Department efforts to secure an S.B.A. grant for the creation of a Small Business Development Center, and recommends that negotiations focus on the need for special efforts: a) to promote access to the Center and its services for small businesses located throughout the state; and b) to address the needs of business in the start-up stages.

Such a Center should also be actively involved with publicizing new and existing federal initiatives. For example, to clarify and publicize the provisions of the new federal Small Business Innovation Research (SBIR) program and encourage small businesses in North Carolina to participate in this initiative, a "Small Business Research and Development Conference" was held January 26, 1983. Over 350 people from throughout the state participated in this Conference, of which about 75 percent represented small businesses. As a follow-up to this conference, a "Workshop on SBIR Proposal Preparation" was held February 24, 1983 on the campus of N.C. State University, for small businesses and entrepreneurs intending to submit proposals during this year's cycle of SBIR awards. A similar workshop was organized by Central Piedmont Community College and SBA-Charlotte on February 17, 1983.

In both the planning and conduct of the conference and the workshops, North Carolina institutions of higher education -- public and private -- have provided extensive and invaluable support. And there is every indication that our universities, colleges and community colleges are planning to take an even more active and long-term role in providing support services to North Carolina businesses.

To ensure that North Carolina small businesses receive their fair share of SBIR and other federal monies, assistance should be provided to small businesses interested in submitting proposals. Incubator facilities should provide this type of service as part of their technical and management support initiatives. Universities and colleges are already engaged in providing advice of this type on an ad hoc basis. However, there is a need for a central clearinghouse for advice for small businesspersons located in all regions of the state. A Proposal Assistance Team should be established formally, to ensure that management and technical questions of small businesses are referred to the appropriate experts in the academic and business communities. Either the mandate of the North Carolina Technological Development should be broadened to include this function, or responsibility for a Proposal Assistance Team should be included among the functions of the proposed Small Business Development Center.